

MEMORANDUM

To: Jayantha Obeysekera, Director, HSM

Through: Luis Cadavid, Sr. Supervising Engineer, HSM
Ken Tarboton, Sr. Supervising Engineer, HSM

From: Alaa Ali, Sr. Engineer, HSM
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Date: August 21, 2000

Subject: Effect of Increased Rock Mining in Lake Belt Area for
2050-Base and ALTD13R Restudy Simulations

Introduction

The purpose of this memorandum is to investigate the hydrologic effect of increased rock mining activities within the Lake Belt area, henceforth called LKBT, (Figure 1). In the Restudy process, all permitted rock-mining areas were assumed to be fully mined by 2050. These areas were simulated as deep bodies of open water in the South Florida Water Management Model, V3.5, (henceforth called SFWMM). The SFWMM grid cell representations of the LKBT rock mining for the 2050 Base (50BSR), and the Restudy selected alternative D13R (AD13R) are depicted in Figures 2a and 2b (areas in black) respectively. The difference between the 50BSR and the AD13R is the incorporation of the North and Central LKBT Reservoirs, which are sealed by impervious barriers, in the AD13R simulation as shown in Figure 2b. In this investigation, additional rock mining areas in the LKBT were incorporated and the new modified simulations are referred to as (50LB) and (AD13RLB). The additional rock mining areas are represented in the SFWMM by the cross hatched areas shown in Figures 2a and 2b for 50LB and AD13RLB respectively. The impacts of these modifications on the hydrologic system are summarized below.

Parameter changes and Assumptions

The boundaries of the LKBT area, for the purpose of this investigation, are represented by dotted line in Figures 2a and 2b. The SFWMM grid cell representation as depicted in Figures 2a and 2b best approximates the location and the total acreage of the rock mining areas. Features at a smaller scale than the 2 mile by 2 mile grid resolution, such as the buffer zone at the western edge of the LKBT area (Figure 1) were not modeled. The LKBT deep bodies of open water for the AD13RLB (including the LKBT reservoirs) have a total area of 29400 acres and are represented by 11 cells (28160 acres), an increase of 4 cells (10200 acres) over AD13R. The LKBT deep bodies of open water for the 50LB have a total area of 26450 acres and are represented by 10 cells (25600 acres), an increase of 5 cells (12800 acres) over 50BSR.

Adding new rock mining areas required changes in certain model parameter values for the modified cells (cross-hatched areas in Figure 2). The new parameter values are summarized in Table 1. More details about these changes in the SFWMM static input parameter file “statdta” can be found in Appendix A.

Table 1. Parameter values of the additional rock mining areas.

Parameter	Land Surface Elevation	Hydraulic Conductivity	Storage Coefficient	Basin Index (CBN)	Land use	Irrigation Acreage
New value	-55 ft.	6.5 ft./day	0.80	30	20	0

Summary of results

The increased mined area had a direct impact on the groundwater flow and levee seepage in the LKBT area and its vicinities. Eastward groundwater flow and seepage from WCA3B and the Pennsuco Wetlands to LKBT significantly increased, reducing stages in these two water bodies and raising stages in adjacent Lower East Coast areas. In WCA3B, hydroperiods were shorter and ponding depths were smaller; however, the hydroperiod and ponding matches with NSM increased. Hydroperiods were significantly reduced in the Pennsuco Wetlands on the West side of the LKBT modified area, whereas stages were generally higher in LEC cells east of that area. The effect of the additional mining area on the groundwater flow has no effect further than about 4 miles east of LKBT eastern boundary. There were no significant impacts in the remainder of the SFWMM domain.

Detailed evaluation

Groundwater flow and levee seepage.

The inclusion of deep water bodies in the LKBT area increased the total seepage just upstream (i.e., west and north) of this area. Subsurface flow components come mainly from WCA3B through groundwater and L30 and L33 levees. Due to the presence of the reservoir barriers, there is no northerly seepage across these barriers in the AD13RLB simulation. Cell by cell representations of west to east subsurface flow for the four simulations are depicted in Figure 3. Mean annual groundwater flow and levee seepage results are summarized in Table 2.

Groundwater flow from WCA3B and Pennsuco wetlands to LKBT increased significantly west of the modified area (column 28 in Figure 3). The behavior of the west-to-east groundwater flow from column 26 through column 36 is also presented in Figures 4a through 4d for rows 23 through 26 respectively. The flow behavior beyond column 32 is the same for all simulations, which can be approximated by a distance of 4 miles east of LKBT eastern boundary. West of this column, the flow pattern of 50BSR simulation is different from that of AD13R simulation (the solid lines). This difference vanishes significantly between the 50LB and AD13RLB simulations (the dashed lines). Notice the

negative flow (westward) at column 29 due to the effect of the wellfield zone (see Figure 3).

Figure 5 shows the groundwater eastward flow across transect “a” (just west of the modified area, see Figures 2, and 3). No change is observed north of row 27 for 50LB and north of row 26 for AD13RLB. Significant increase is noticed at row 27 for 50LB and at row 26 for AD13RLB showing consistency with the modified area in each simulation. From Table 2, annual groundwater flow increased by 107,000 and 75,000 acre-ft for 50LB and AD13RLB respectively. The significant difference is due to the conversion of cell R27C27 in 50LB whereas the same cell in AD13RLB is within the central LKBT reservoir.

Figure 6 shows the levee seepage across L30 and L33 for both simulations. The 50LB annual seepage has decreased by 41,000 acre-ft as a result of stage difference reduction across the levee due to increase of groundwater flow across that levee. The AD13RLB levee seepage change south of the central reservoir barrier was insignificant (an increase of 1500 acre-ft). However, a levee seepage increase of 7,000 acre-ft was observed just north of that barrier (column 27 and row 28).

Figure 7 shows the groundwater eastward flow across transect “b” (the eastern boundary of LKBT area). The change of groundwater flow across this line is 13,000 acre-ft for both cases (Table 2) indicating a uniform effect of the mining activities for the two simulations.

Table 2. Eastward subsurface flow across selected transects between row 23 and row 28.

Type of simulation	flow in Acre-ft/year					
	Groundwater across transect “a” *	Levee seepage for L30 and L33	Total Inflow	Net inflow increase	Groundwater across transect “b” *	Net Outflow increase
50BSR	128000	245000	373000		19000	
50LB	235000	204000	439000	66000	32000	13000
AD13R	95000	149000	244500		19000	
AD13RLB	170000	158000	328000	84000	32000	13000

(*) Transects “a” and “b” are shown on Figure 2.

Figure 8 shows the groundwater flow eastward at transect “c” (4 miles east to LKBT boundary). Groundwater flow across this line is approximately 10,000 acre-ft for all 4 simulations (Table 3) indicating a vanishing effect of the mining activities.

Water Conservation Area 3B

Increased subsurface flow from WCA3B resulted in water stage in WCA3B. This reduction is reflected in shorter hydroperiods and shallower ponding depths in both the 50LB and AD13RLB simulations with respect to the baseline simulations. The Indicator Regions report (IR 15 and 16 in Appendix B) shows that the average annual hydroperiod for both simulations decreased by 1% in Indicator Region 15 (West WCA-3B) and by 3% in Indicator Region 16 (East WCA-3B). The average inundation decreased from 398

weeks/event in AD13R to 264 weeks/event in AD13RLB for IR15 and from 315 to 118 weeks/event for IR16. Appendix C shows that NSM hydroperiod matches increased in the AD13RLB simulation by 11.1% while the hydroperiod matches decreased in the 50LB simulation by 7.5%. NSM ponding depth matches increased in AD13RLB and 50LB by 11.1% and 3.7% respectively. More details can be found in Appendix B and C.

Table 3. Groundwater flow at SFWMM column 32 near LKBT area

Type of simulation	flow in Acre-ft/year	
	Groundwater across transect "c" *	Net Groundwater Change
50BSR	9600	
50LB	10500	900
AD13R	9400	
AD13RLB	10300	900

(*) Transects "c" is shown on Figure 2.

Pennsuco Wetlands

Pennsuco Wetlands are represented by Indicator Regions 52 and 53 (just west of the modified LKBT area). Eastward groundwater flow from this area to the LKBT area, transect "a", increased by 107,000 and 75,000 acre-ft/yr for B50LB and AD13RLB respectively (see Figures 4a-d, Figure 5, and Table2). This flow reduced water stage by 0.4 to 0.8 ft. and shortened the hydroperiods by 15% to 18% (see Appendix D). The Indicator Regions report (Appendix B) shows that for AD13RLB, the average annual hydroperiod in Indicator Region 52 (Pennsuco Wetlands North) decreased by 19%, whereas in Indicator Region 53 (Pennsuco Wetlands South), the annual hydroperiod decreased by 14%. The corresponding changes for 50LB are 15% and 13% respectively.

Lower East Coast (LEC)

The LKBT modifications affected the nearby parts of LEC. Appendix E provides stage duration curves for all cells located within this zone (rows 23 through 28 and columns 28 through 30). From this Appendix, the following is observed:

- 1) The area within rows 23 through 26 and transects "a" and "b":

Increased subsurface flow into this area increased the surface water stages significantly for both simulations. In many areas, the stage increase is higher for the AD13RLB than the 50LB. This difference is due to the higher net inflow for AD13RLB as explained earlier. This difference decreases southward from LKBT reservoirs. The reservoir barriers cause a confining effect in the northern boundary and hence an increase in stages.

2) The Central LKBT Reservoir

The stage in this reservoir (cells: Row 27; and column 28 and 29) is slightly lower for the AD13RLB simulation compared to AD13R.

3) The North LKBT Reservoir

The stage in this reservoir (cells: Row 28, and column 29 and 30) is slightly higher for both modified simulations.

Conclusion

In this investigation parts of the LKBT area were converted into deep bodies of open water for the purpose of simulating the impact of increased mining activities on the hydrologic system. These parts were approximated in the SFWMM by the cross-hatched cells in Figures 2a and 2b for the 2050 Base and the Restudy Alternative AD13R respectively. The results of the SFWMM simulation indicate a significant change in groundwater flow and levee seepage within the LKBT area. The net inflow from WCA3B and Pennsuco Wetlands to the LKBT area increased by 18% and 34% for the 50LB and AD13RLB respectively. This increase reduced the stages in WCA3B and the Pennsuco Wetlands reflecting shorter hydroperiods by 1% to 3 % for WCA3B, and by 13% to 19% for Pennsuco. Stages within LKBT area were increased. The effects of the proposed increased mining were not detected further than 4 miles east of the LKBT eastern boundary. No significant impacts on the stages in the Northern and Central LKBT reservoirs were observed. The remaining parts of the SFWMM domain showed no significant impact due to the increased mining area.

References

Restudy Alternative D13R:

<http://www.sfwmd.gov/org/pld/restudy/hpm/frame1/alts/altd13rsum.htm>

Restudy 2050 Base:

http://www.sfwmd.gov/org/pld/restudy/hpm/frame1/alts/95bsr_50bsr_desc.pdf

A Primer to the South Florida Water Management Model (SFWMM) Version 3.5, April 1999, South Florida Water Management District:

<http://www.sfwmd.gov/org/pld/hsm/models/sfwmm/>

Lake Belt Study Area

- [Hatched Box] Areas of Disagreement
- [Hatched Box] Environmental
- [Hatched Box] Mining
- [Hatched Box] Water Management
- [Hatched Box] Environmental/Water Management
- [Hatched Box] Suitable for Rock Mining and other Existing Land Uses
- [White Box] Mining allowable in five years unless needed for Everglades Restoration (no permit at this time)
- [Hatched Box] Other Existing Land Uses, Rock Mining not Recommended
- [Hatched Box] Other Existing Land Uses/Water Management
- [White Box] Permit for Mining, no new activity for five years
- [Hatched Box] Permit for Mining, no new activity for three years

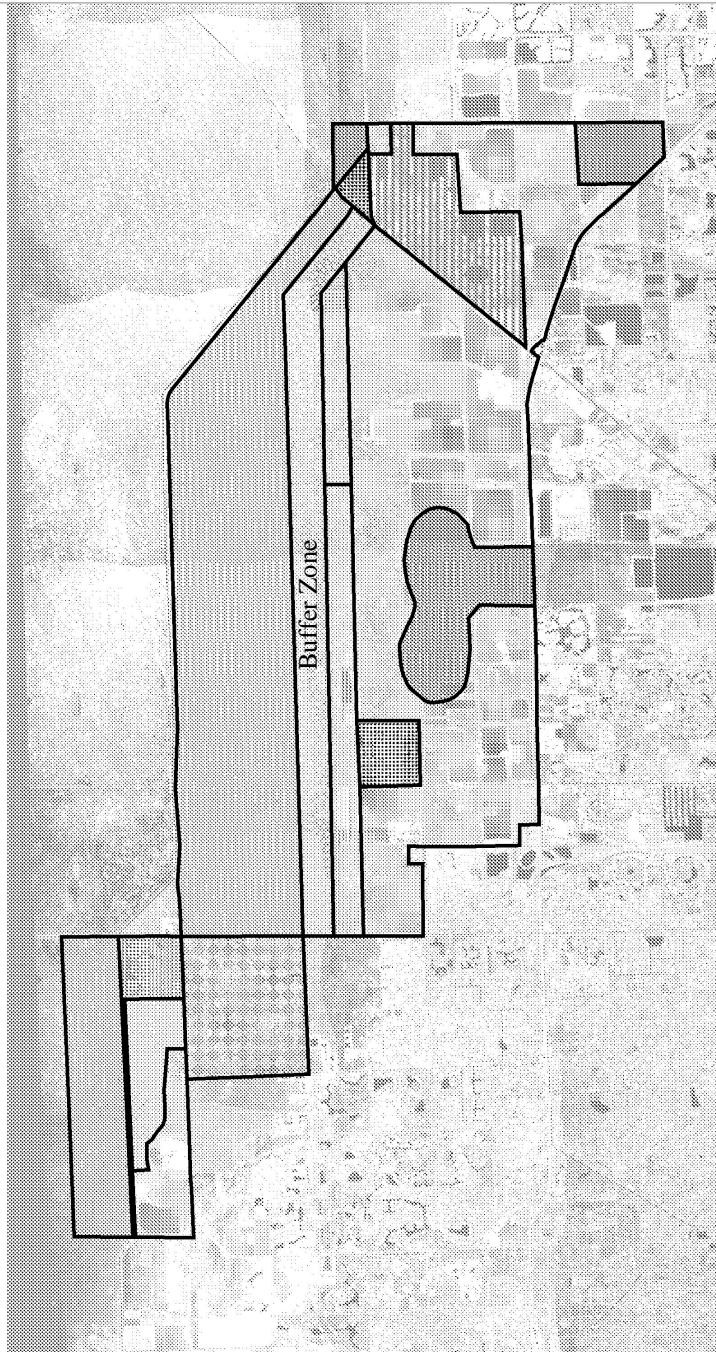
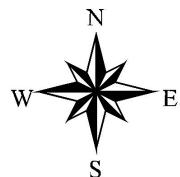


Figure 1. A general layout of the Lake Belt Area.

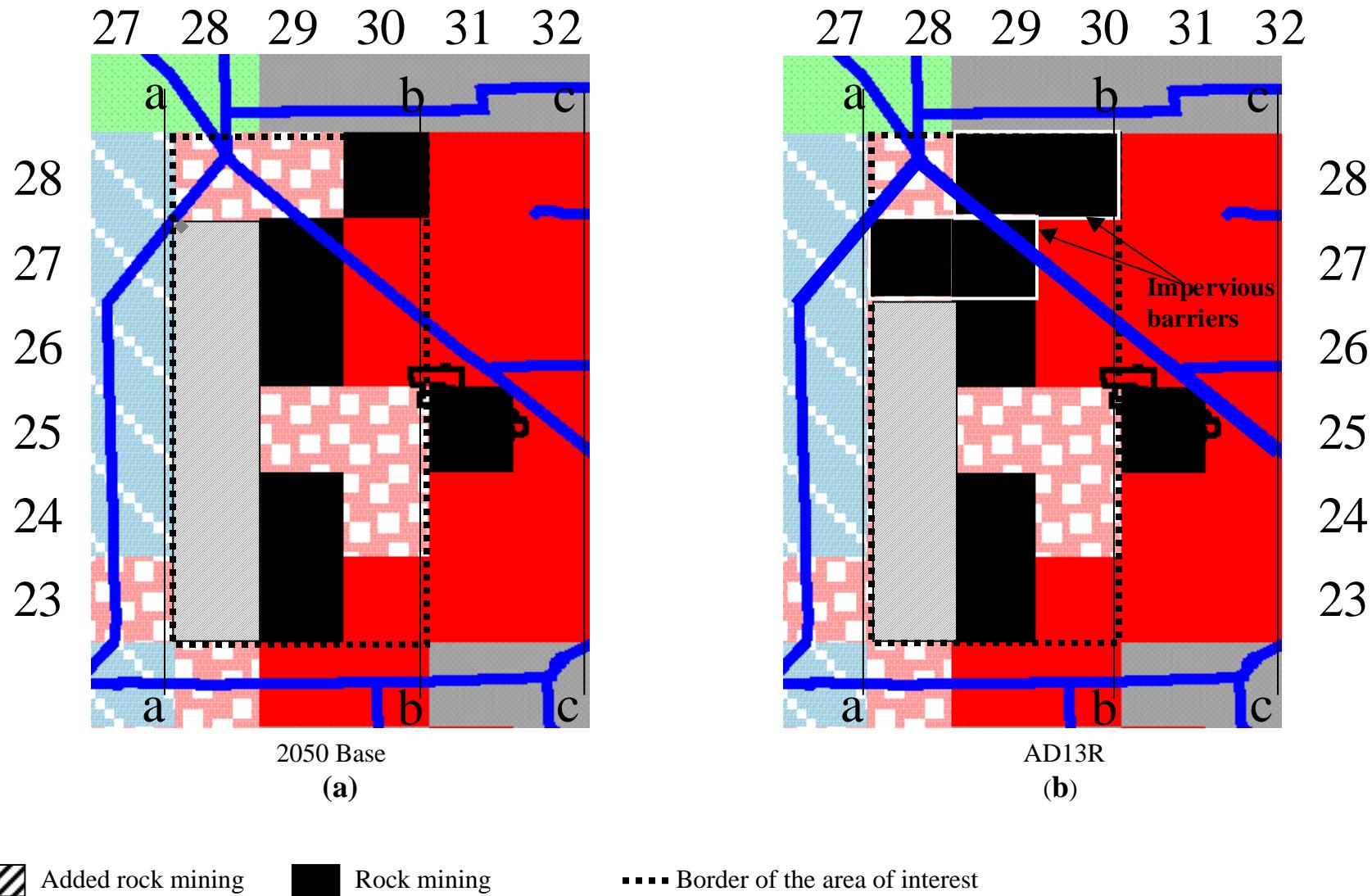


Figure 2. LKBT area representation in SFWMM model grid before (areas in black) and after (hatched areas) modifications for 2050 and AD13R baselines.

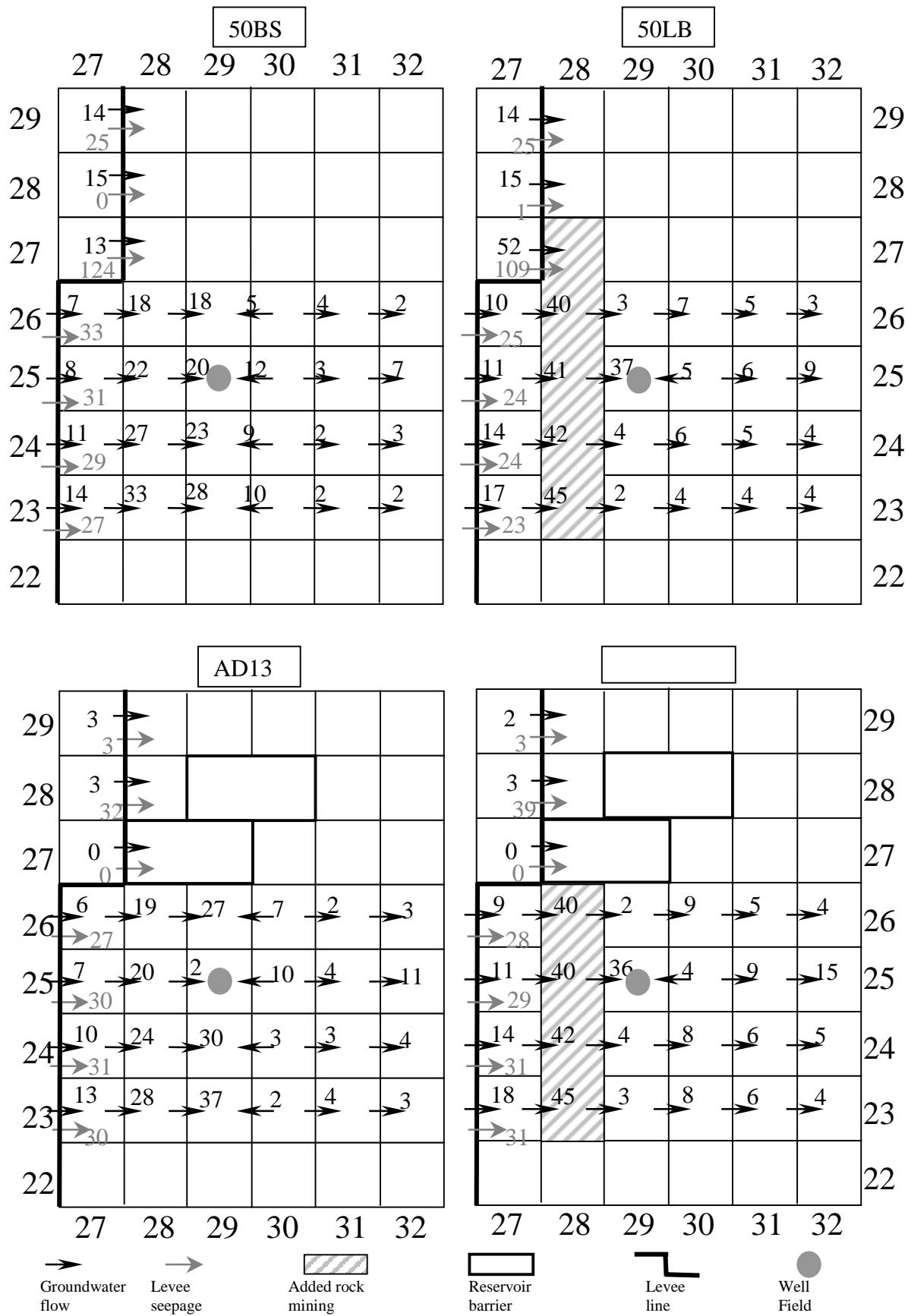


Figure 3. Horizontal subsurface flow in 1000 acre-ft, before and after modifications for B50 Base and AD13R.

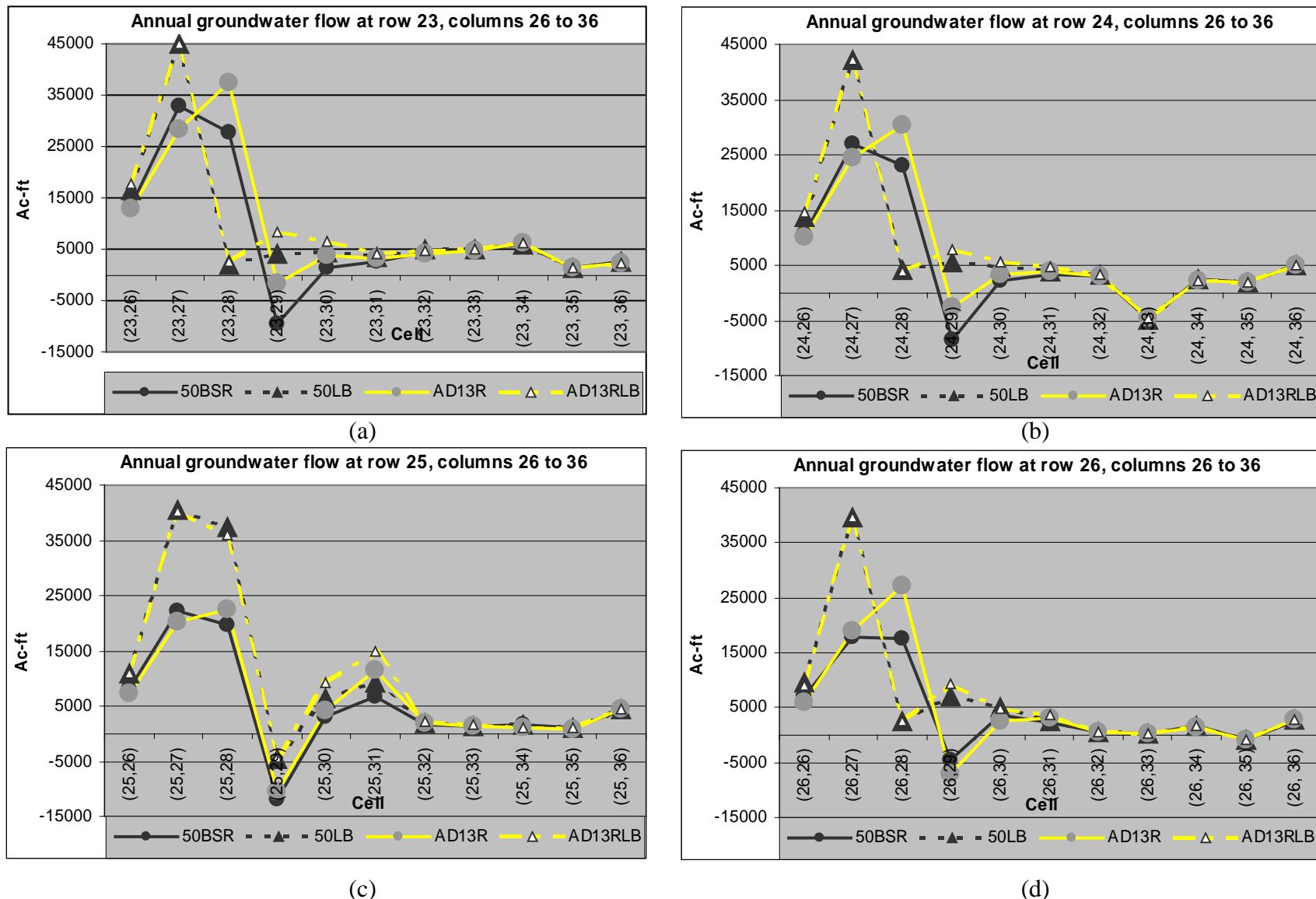


Figure 4. Annual groundwater eastward seepage within the LKBT area at rows 23 to row 26.

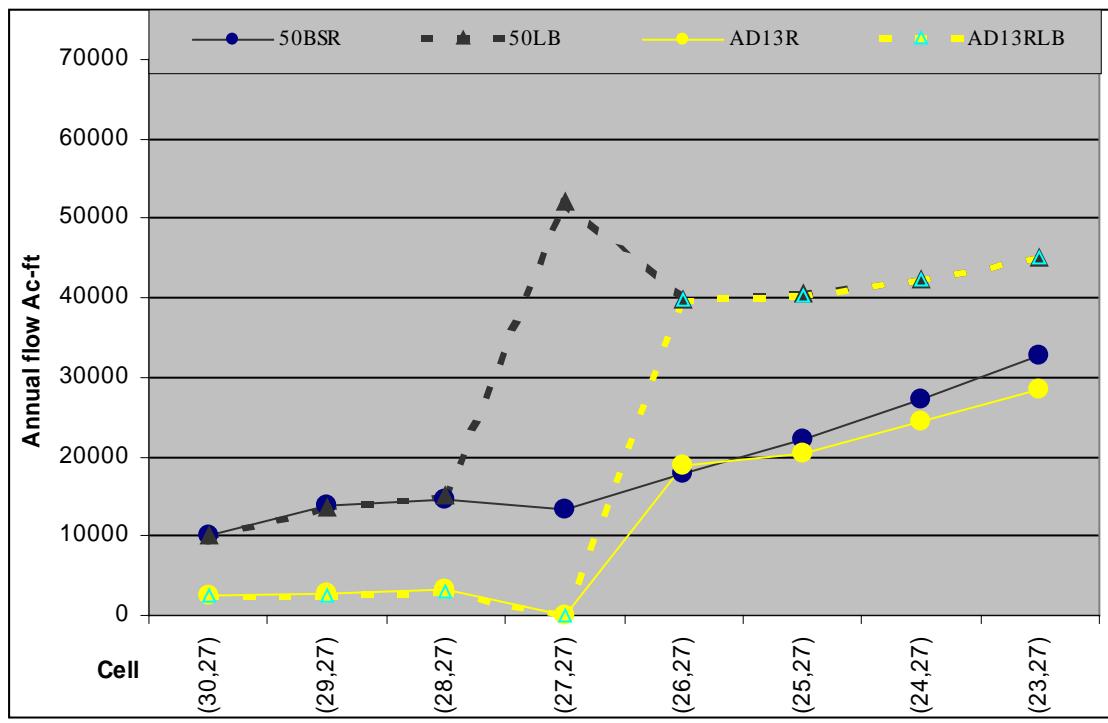


Figure 5 Groundwater flow from WCA3B to LKBT across transect "a".

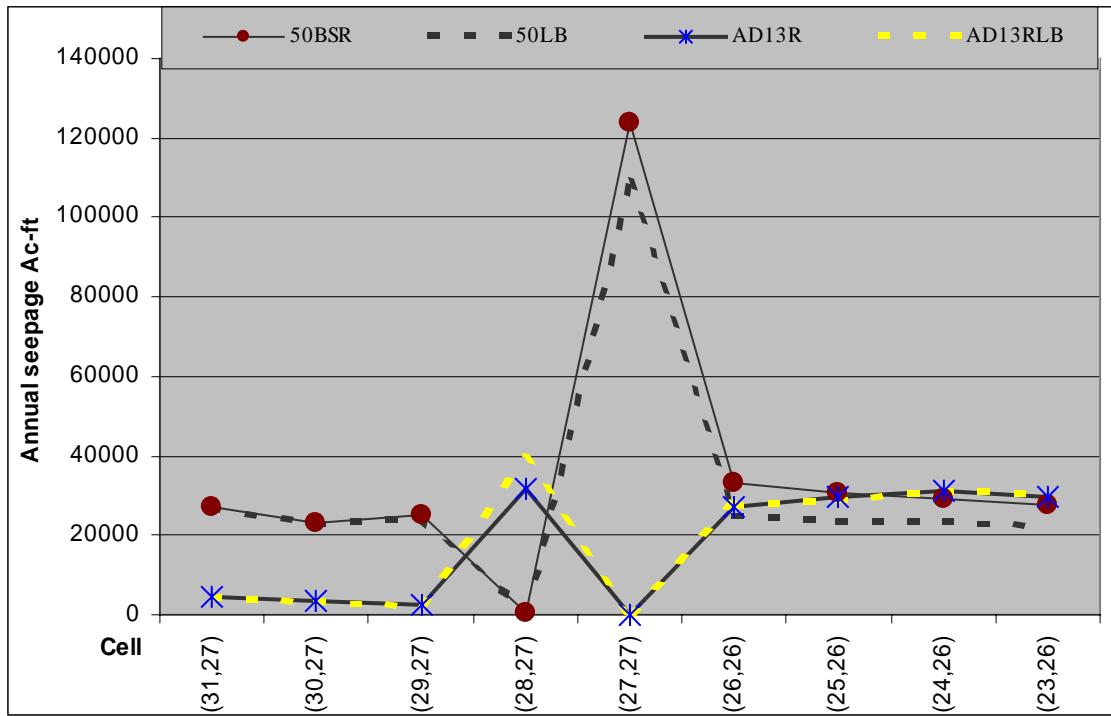


Figure 6. Levee seepage from WCA3B to LKBT across L30 and L33 Levees.

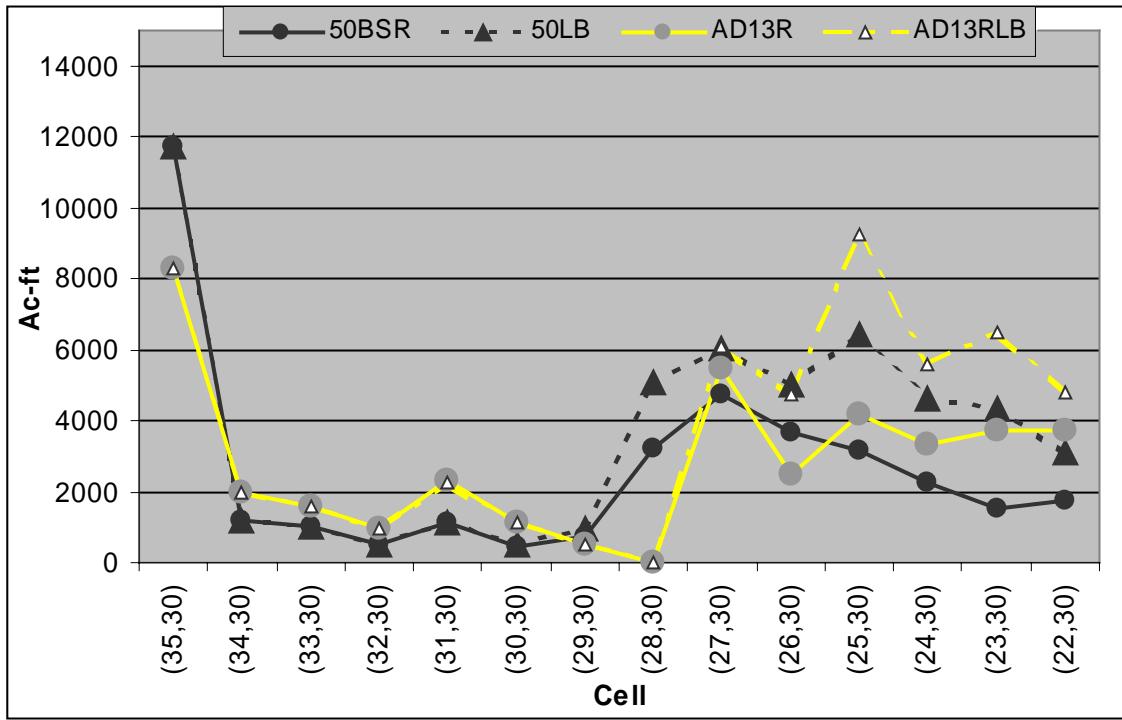


Figure 7. Groundwater flow from LKBT to LEC across transect “b”.

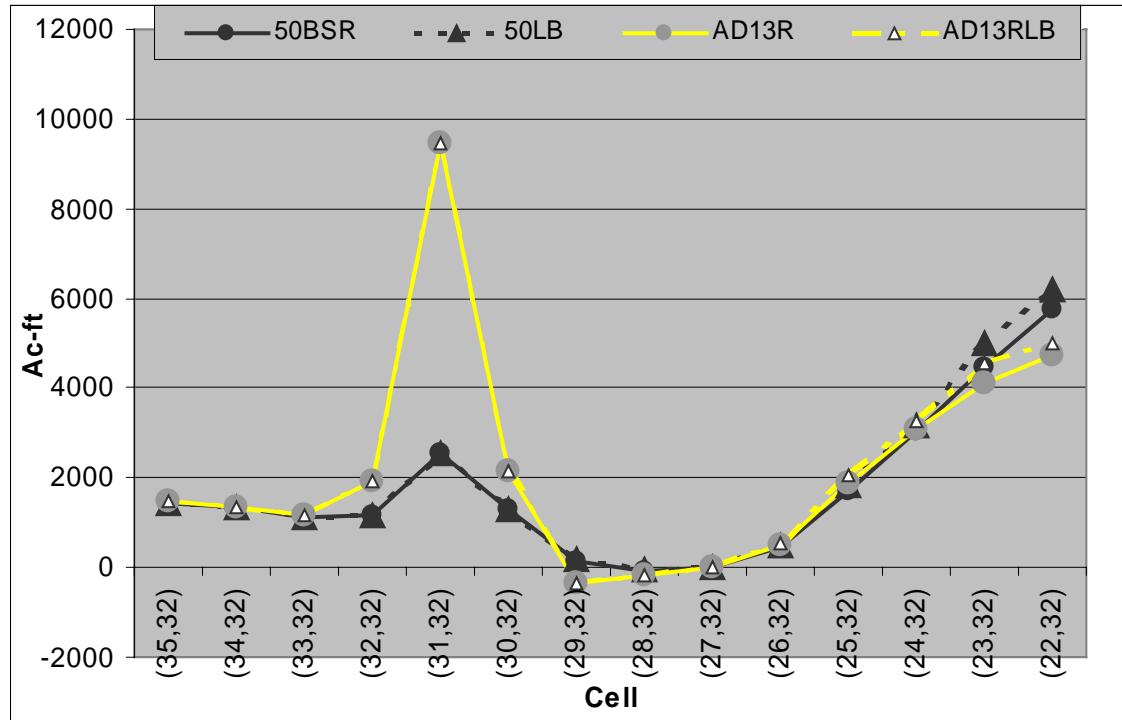


Figure 8. Groundwater flow from LKBT to LEC across transect “c”.

APPENDIX A

Difference between 50BSR and 50LB parameters in input file statdta.

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Difference between D13R and D13RLB static parameters in input file statdata.

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< TKX 23 26 35 2.067 2.950 6.500 6.500 1.047 0.982 0.915 0.870 0.826 0.800
---
> TKX 23 26 35 2.067 2.950 2.322 6.500 1.047 0.982 0.915 0.870 0.826 0.800
1584c1584
< LSC 24 27 37    0.    0.    0.    299.   374.   267.   942.   607.   1058.   658.
0.
---
> LSC 24 27 37    0.    21.   0.    299.   374.   267.   942.   607.   1058.   658.
0.
1587c1587
< LSC 23 28 37    0.    0.    372.   177.   144.   403.   676.   825.   455.   0.
---
> LSC 23 28 37    98.   0.    372.   177.   144.   403.   676.   825.   455.   0.

```

Appendix B

Inundation Duration Summary for Indicator Regions

Indicator Region Number	Name	#Events		Avg Flood Dur (Wks/Event)				Avg Ann Hydper (Percent of Yr)								
		NSM45F	50BSR	50LB	AD13R	AD13RLB										
1	Taylor Slough	37	33	76	38	30	71	38	30	71	36	32	72	36	32	71
2	West Perrine Marl Marsh	68	9	39	70	9	38	70	9	38	66	10	39	68	9	39
3	Mid-Perrine Marl Marsh	43	23	60	51	17	53	50	17	53	49	18	54	51	17	53
4	C-111 Perrine Marl Marsh	47	21	62	71	13	59	70	13	59	45	27	76	44	28	76
5	Model Lands South	55	19	64	71	14	60	70	14	60	35	39	84	35	39	84
6	Model Lands North	43	27	72	87	7	36	89	7	36	109	7	45	111	7	45
7	Ochopee Marl Marsh	35	32	70	37	29	68	37	30	68	37	29	66	41	26	66
8	Rockland Marl Marsh	37	28	65	42	17	45	41	18	46	35	28	60	36	27	59
9	SW Shark River Slough	9	176	98	15	98	91	15	98	91	9	174	97	9	173	97
10	Mid Shark River Slough	5	321	100	14	108	94	14	108	94	5	318	99	5	318	99
11	NE Shark River Slough	4	402	100	21	68	89	21	68	88	6	265	98	4	394	98
12	New Shark River Slough	32	42	82	32	40	80	32	40	80	25	56	87	27	52	87
13	West Slough	38	28	66	38	31	74	40	30	74	34	32	67	34	32	67
14	South WCA-3A	17	88	92	15	101	94	16	95	94	11	139	95	11	139	95
15	West WCA-3B	20	74	92	19	79	93	20	74	92	4	398	99	6	264	98
16	East WCA-3B	15	102	95	28	50	86	29	46	83	5	315	98	13	118	95
17	South Central WCA-3A	24	59	87	24	59	88	24	59	88	16	96	95	15	102	95
18	North Central WCA-3A	24	59	89	21	69	89	21	69	89	10	155	96	11	141	96
19	East WCA-3A	25	55	86	15	100	93	15	100	93	13	116	93	13	116	93
20	NW WCA-3A	21	70	91	27	51	86	27	51	86	22	65	88	25	57	88
21	NE WCA-3A	28	49	85	20	73	91	21	70	91	32	42	84	30	45	84
22	NW Corner WCA-3A	20	73	91	19	77	91	20	73	91	17	90	95	21	72	94
23	WCA-2B	21	70	92	17	82	86	16	87	86	20	66	81	20	66	81
24	South WCA-2A	20	74	91	16	90	89	16	90	89	18	78	88	18	78	88
25	North WCA-2A	30	46	86	19	77	90	19	77	90	16	93	92	17	87	92
26	South LNWR (WCA-1)	25	57	89	16	95	94	16	95	94	7	228	99	7	228	99
27	North LNWR (WCA-1)	15	99	92	20	72	90	20	72	90	17	90	95	17	90	95
28	Rotenberger WMA	40	31	76	38	34	79	38	34	79	42	30	79	42	30	79
29	Holey Land WMA	28	50	88	12	128	95	12	128	95	31	45	87	29	49	88
30	Corbett WMA	61	13	50	55	4	13	56	4	13	56	3	11	55	3	11
31	Mullet Slough	64	14	56	57	13	46	57	13	46	59	14	50	58	14	50
32	Upland Pine	56	15	51	57	15	52	57	15	52	57	15	52	57	15	52
33	Upper Mullet Slough	64	8	33	64	8	33	64	8	33	65	8	33	65	8	33
34	Cypress Marsh	36	35	78	42	12	31	42	12	31	42	12	31	42	12	31
35	Wet Prairie	31	43	82	42	19	50	42	19	50	42	19	50	42	19	50

36	Wetter Prairie NE	59	18	65	68	14	57	68	14	57	65	15	59	65	15	59
37	Wetter Prairie SW	58	17	63	71	12	54	72	12	54	67	14	58	67	14	58
38	Drier Cypress NW	67	10	40	68	9	38	68	9	38	69	9	38	68	9	39
39	Drier Cypress NE	62	14	55	64	12	48	64	12	48	66	12	50	66	12	50
40	Cypress	48	23	67	53	20	64	53	20	64	48	22	65	48	22	65
41	NW Big Cypress	54	16	53	59	12	46	59	12	46	59	12	46	59	12	46
42	NE Big Cypress	44	22	61	56	12	43	56	12	43	55	16	53	55	16	53
43	NE Corner Big Cypress	39	31	75	38	4	9	38	4	9	45	14	38	45	14	38
44	SW Big Cypress	62	14	54	60	14	54	60	14	54	60	14	54	60	14	54
45	Racoon Point	61	11	42	65	10	39	65	10	39	64	10	40	64	10	40
47	North C-111	48	20	60	58	4	14	58	4	14	57	10	35	55	10	35
48	North Bisc. Bay Groundwater 1	14	7	6	0	0	0	0	0	0	0	0	0	0	0	0
49	North Bisc. Bay Groundwater 2	49	15	46	0	0	0	0	0	0	0	0	0	0	0	0
50	Central Bisc. Bay Groundwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	South Bisc. Bay Groundwater	34	5	10	0	0	0	0	0	0	0	0	0	0	0	0
52	Pennsuco Wetlands North	21	70	91	30	43	79	38	27	64	14	110	96	25	50	77
53	Pennsuco Wetlands South	9	176	98	37	32	74	40	25	61	20	73	91	23	54	77
46	Cape Sable Sparrow A	37	30	68	34	34	72	32	36	71	35	31	66	35	30	66
54	Cape Sable Sparrow B	69	9	40	68	9	39	68	9	39	66	10	40	66	10	40
55	Cape Sable Sparrow C	40	22	54	43	15	39	43	15	40	35	22	47	35	21	46
56	Cape Sable Sparrow D	45	22	61	58	15	53	58	15	53	54	16	54	53	16	53
57	Cape Sable Sparrow E	47	17	50	56	11	39	55	12	39	39	20	47	38	20	47
58	Cape Sable Sparrow F	36	30	67	40	17	42	39	18	44	39	24	58	40	23	58
59	Western WCA-3A Snail Kite	22	66	90	33	40	82	33	40	82	14	109	95	13	117	95
60	Southern WCA-3A Snail Kite	18	83	92	19	77	91	19	77	91	19	78	92	20	74	92
61	WCA-2B1	20	72	89	24	50	74	24	50	74	45	22	62	46	22	62
62	WCA-2B2	24	61	91	20	65	80	20	65	80	50	19	60	51	19	60
63	WCA-2B3	20	74	92	16	91	91	16	91	91	20	71	89	20	71	89
64	WCA-2B4	25	56	87	8	199	99	7	227	99	5	319	99	5	319	99
65	WCA-2B5	14	110	95	10	149	93	10	149	93	14	106	92	14	106	92
66	N WCA-3B	27	49	82	22	66	89	27	51	86	11	142	97	14	109	95
67	NE WCA-3B	22	62	85	35	29	63	36	28	63	22	62	84	26	50	80
68	S of NE WCA-3A	28	50	86	28	51	88	28	51	88	29	49	87	26	54	88
69	L-67A	20	69	86	16	97	96	15	103	96	15	102	95	14	109	95
70	Eastern edge of SRS	58	17	61	58	16	57	58	16	57	55	18	61	56	17	61

Notes: #events = number of continuous ponding events over the period of record

Avg Flood Duration = [sum(days of ponding)/7]/#events

Avg Annual Hydroperiod = 100 x [sum(weeks of ponding per year)]/[52 x #years]

High Water Summary for Indicator Regions

Indicator Region Number	Name	Depth(ft) Criterion	#Events Avg Duration (Wks/Event) Avg Ann Duration(Percent of Yr)														
			NSM45F			50BSR			50LB			AD13R			AD13RLB		
1	Taylor Slough	> 1.5	10	2	1	5	2	0	5	2	0	5	2	1	5	2	1
2	West Perrine Marl Marsh	> 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Mid-Perrine Marl Marsh	> 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	C-111 Perrine Marl Marsh	> 2.0	0	0	0	0	0	0	0	0	0	10	3	2	10	3	2
5	Model Lands South	> 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Model Lands North	> 1.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Ochopee Marl Marsh	> 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Rockland Marl Marsh	> 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	SW Shark River Slough	> 2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Mid Shark River Slough	> 2.5	5	11	4	1	1	0	1	1	0	4	8	2	5	6	2
11	NE Shark River Slough	> 2.5	15	10	9	0	0	0	0	0	0	10	6	4	8	6	3
12	New Shark River Slough	Undefined															
13	West Slough	Undefined															
14	South WCA-3A	> 2.5	0	0	0	10	9	6	10	9	6	2	9	1	2	9	1
15	West WCA-3B	> 2.5	6	6	2	6	12	5	7	9	4	6	9	3	5	10	3
16	East WCA-3B	> 2.5	7	9	4	15	9	8	16	8	8	15	7	6	13	7	5
17	South Central WCA-3A	> 2.5	0	0	0	4	9	2	4	9	2	3	7	1	2	9	1
18	North Central WCA-3A	> 2.5	0	0	0	2	10	1	2	10	1	3	7	1	3	7	1
19	East WCA-3A	> 2.5	0	0	0	23	8	11	23	8	11	31	10	20	31	10	20
20	NW WCA-3A	> 2.5	0	0	0	1	6	0	1	6	0	1	1	0	1	1	0
21	NE WCA-3A	> 2.0	2	2	0	2	9	1	2	8	1	6	8	3	6	7	3
22	NW Corner WCA-3A	> 2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	WCA-2B	> 2.5	4	5	1	15	60	56	15	60	56	24	7	10	24	7	10
24	South WCA-2A	> 2.5	0	0	0	5	2	1	5	2	1	4	5	1	4	4	1
25	North WCA-2A	> 2.5	0	0	0	1	1	0	1	1	0	2	1	0	2	1	0
26	South LNWR (WCA-1)	> 2.5	0	0	0	27	12	20	27	12	20	31	13	25	31	13	25
27	North LNWR (WCA-1)	> 2.5	0	0	0	1	1	0	1	1	0	1	1	0	1	1	0
28	Rotenberger WMA	> 1.5	17	5	5	0	0	0	0	0	0	0	0	0	0	0	0
29	Holey Land WMA	> 1.5	22	8	12	32	21	41	32	21	41	30	4	7	30	4	7
30	Corbett WMA	Undefined															
31	Mullet Slough	Undefined															
32	Upland Pine	Undefined															
33	Upper Mullet Slough	Undefined															
34	Cypress Marsh	Undefined															
35	Wet Prairie	Undefined															
36	Wetter Prairie NE	Undefined															
37	Wetter Prairie SW	Undefined															
38	Drier Cypress NW	Undefined															
39	Drier Cypress NE	Undefined															

Notes: #events = number of events with depths continuously greater than the criterion over the period of record

Avg Duration of High Water Events = [sum(days over criterion)/7]/#events

Avg Annual Duration of High Water(Percent) = 100 x [sum(weeks over criterion)]/[52 x #years]

Low Water Summary for Indicator Regions

Indicator Region Number	Indicator Region Name	Depth(ft) Criterion	#Events Avg Duration (Wks/Event)												Avg Ann Duration(Percent of Yr)					
			NSM45F			50BSR			50LB			AD13R			AD13RLB					
1	Taylor Slough	< -1.5	20	4	5	28	4	7	28	4	7	28	4	7	28	4	7	7		
2	West Perrine Marl Marsh	< -1.5	36	7	16	38	7	17	37	8	17	36	7	16	36	7	16	16		
3	Mid-Perrine Marl Marsh	< -1.5	28	8	13	30	4	8	31	4	8	33	4	8	36	4	9	9		
4	C-111 Perrine Marl Marsh	< 0.5	54	24	80	34	40	84	35	38	83	53	17	55	51	18	56	56		
5	Model Lands South	< 0.5	56	23	81	41	37	95	41	37	95	80	14	68	79	14	68	68		
6	Model Lands North	< 0.2	54	14	46	44	35	95	45	34	95	51	29	93	51	29	93	93		
7	Ochopee Marl Marsh	< -1.5	17	8	9	22	7	10	22	7	10	22	7	10	22	7	10	10		
8	Rockland Marl Marsh	< -1.5	21	10	13	38	10	23	37	10	22	22	10	14	22	10	14	14		
9	SW Shark River Slough	< -1.0	1	5	0	12	4	3	12	4	3	3	2	0	3	3	1	1		
10	Mid Shark River Slough	< -1.0	1	1	0	7	5	2	7	5	2	2	2	0	2	2	0	0		
11	NE Shark River Slough	< -1.0	1	1	0	9	6	3	9	6	3	3	2	0	2	4	0	0		
12	New Shark River Slough	< -1.0	17	7	8	21	6	8	21	6	8	13	5	4	13	5	4	4		
13	West Slough	< -1.5	22	7	10	17	7	7	17	7	7	20	8	10	20	8	10	10		
14	South WCA-3A	< -1.0	8	4	2	4	4	1	4	4	1	4	4	1	4	4	1	1		
15	West WCA-3B	< -1.0	3	2	0	7	2	1	7	3	1	2	3	0	2	4	1	1		
16	East WCA-3B	< -1.0	1	1	0	15	5	5	15	6	6	3	3	1	3	7	1	1		
17	South Central WCA-3A	< -1.0	8	7	3	10	6	4	9	6	3	5	3	1	5	3	1	1		
18	North Central WCA-3A	< -1.0	9	5	3	10	6	3	10	5	3	2	4	0	1	6	0	0		
19	East WCA-3A	< -1.0	10	6	4	9	3	2	9	3	2	8	3	1	7	3	1	1		
20	NW WCA-3A	< -1.0	6	6	2	11	7	5	11	7	5	8	6	3	9	5	3	3		
21	NE WCA-3A	< -1.0	15	7	7	10	7	4	10	6	4	12	6	5	14	5	4	4		
22	NW Corner WCA-3A	< -1.0	7	5	2	11	6	4	11	6	4	6	3	1	5	3	1	1		
23	WCA-2B	< -1.0	5	5	1	11	7	5	11	7	5	14	7	6	14	7	6	6		
24	South WCA-2A	< -1.0	6	8	3	8	8	4	8	8	4	12	7	6	13	7	6	6		
25	North WCA-2A	< -1.0	8	8	4	8	7	3	8	7	3	4	9	2	4	9	2	2		
26	South LNWR (WCA-1)	< -1.0	10	4	2	2	4	0	2	4	0	0	0	0	0	0	0	0		
27	North LNWR (WCA-1)	< -1.0	8	4	2	5	5	1	6	4	1	1	4	0	1	4	0	0		
28	Rotenberger WMA	< -1.0	18	8	9	20	4	6	20	4	6	18	3	4	18	3	4	4		
29	Holey Land WMA	< -1.0	14	6	5	5	2	1	5	2	1	11	4	3	11	4	3	3		
30	Corbett WMA	Undefined																		
31	Mullet Slough	Undefined																		
32	Upland Pine	< -7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
33	Upper Mullet Slough	Undefined																		
34	Cypress Marsh	< -6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
35	Wet Prairie	< -6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
36	Wetter Prairie NE	< -6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
37	Wetter Prairie SW	< -6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
38	Drier Cypress NW	< -5.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
39	Drier Cypress NE	< -5.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

40	Cypress	< -4.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
41	NW Big Cypress	< -3.0	13	5	4	13	5	4	13	5	4	13	5	4	13	5	4	
42	NE Big Cypress	< -3.0	6	5	2	10	6	4	10	6	4	9	5	3	9	5	3	
43	NE Corner Big Cypress	< -3.0	0	0	0	22	6	8	22	6	8	22	6	9	22	6	9	
44	SW Big Cypress	< -3.0	9	6	3	10	7	4	10	7	4	10	7	4	10	7	4	
45	Racoon Point	Undefined																
47	North C-111	< 0.0	47	14	41	58	24	87	58	24	87	56	19	67	55	20	67	
48	North Bisc. Bay Groundwater	1	< -5.1	18	4	5	1	1612	100	1	1612	100	1	1612	100	1	1612	100
49	North Bisc. Bay Groundwater	2	< -5.0	0	0	0	11	145	99	13	123	99	11	146	100	11	146	100
50	Central Bisc. Bay Groundwater	< -7.5	3	3	1	105	10	66	104	10	67	124	8	60	124	8	59	
51	South Bisc. Bay Groundwater	< -3.0	30	9	17	87	12	66	88	12	66	92	11	65	91	11	65	
52	Pennsuco Wetlands North	< -1.0	3 	2 	0 	29 	5 	9 	43 	7 	18 	3 	5 	1 	15 	6 	5 	
53	Pennsuco Wetlands South	< -1.0	1 	1 	0 	31 	7 	13 	33 	9 	19 	5 	6 	2 	17 	6 	6 	
46	Cape Sable Sparrow A	Undefined																
54	Cape Sable Sparrow B	Undefined																
55	Cape Sable Sparrow C	Undefined																
56	Cape Sable Sparrow D	Undefined																
57	Cape Sable Sparrow E	Undefined																
58	Cape Sable Sparrow F	Undefined																
59	Western WCA-3A Snail Kite	Undefined																
60	Southern WCA-3A Snail Kite	Undefined																
61	WCA-2B1	< -1.0	10	5	3	22	10	14	22	10	13	26	10	17	26	10	17	
62	WCA-2B2	< -1.0	6	4	2	16	9	9	16	9	9	25	8	13	25	8	13	
63	WCA-2B3	< -1.0	4	6	1	5	9	3	5	9	3	7	7	3	7	7	3	
64	WCA-2B4	< -1.0	16	4	4	1	6	0	1	6	0	2	3	0	2	3	0	
65	WCA-2B5	< -1.0	4	6	2	16	5	5	16	5	5	13	5	4	13	5	4	
66	N WCA-3B	< -1.0	21 	5 	6 	15 	3 	3 	20 	5 	6 	3 	4 	1 	5 	5 	1 	
67	NE WCA-3B	< -1.0	15 	5 	5 	39 	11 	26 	41 	11 	27 	15 	5 	5 	16 	6 	6 	
68	S of NE WCA-3A	< -1.0	13	5	4	11	6	4	11	6	4	13	4	4	12	4	3	
69	L-67A	Undefined																
70	Eastern edge of SRS	Undefined																

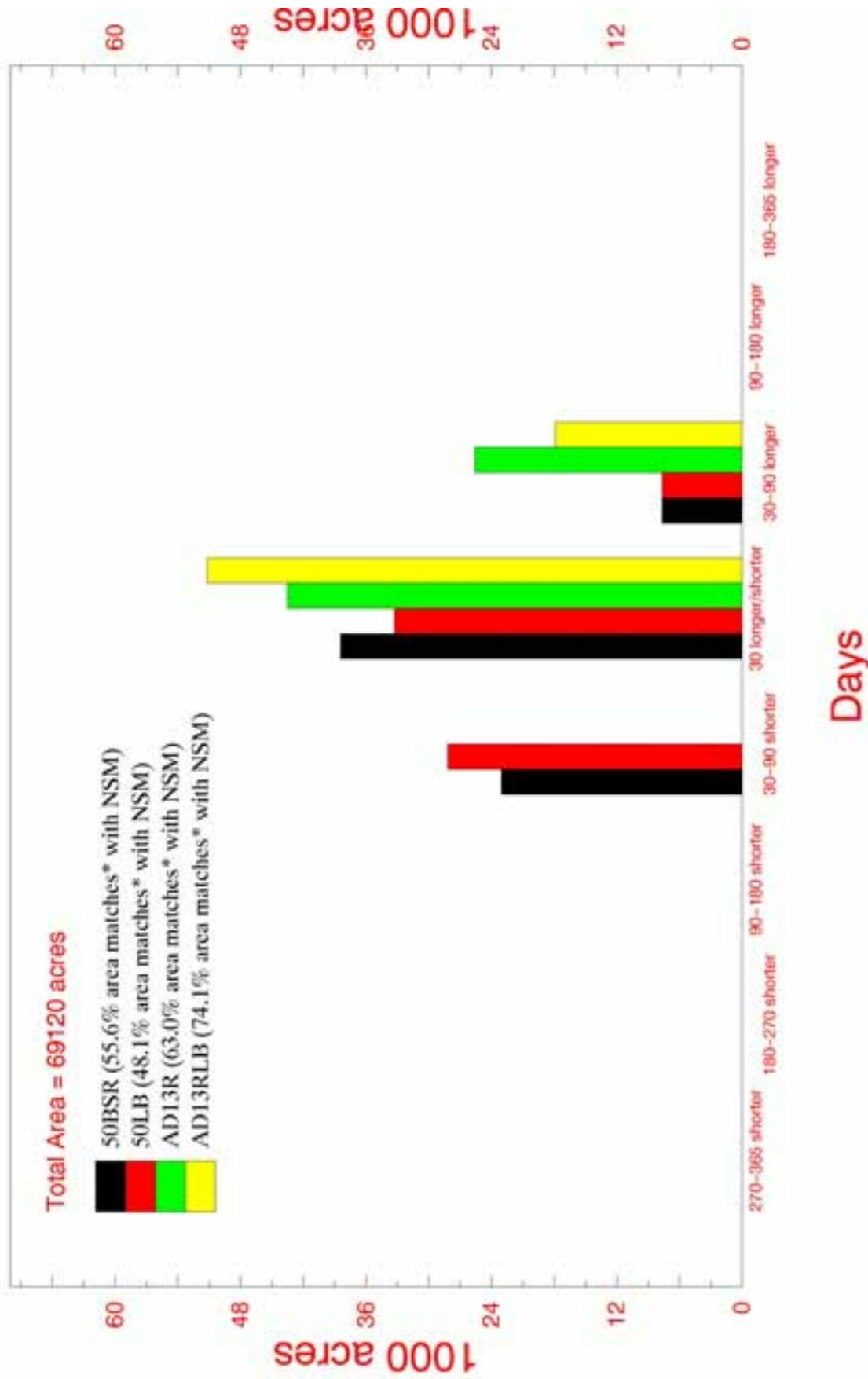
Notes: #events = number of events with depths continuously less than the criterion over the period of record

Avg Duration of Low Water Events = [sum(days below criterion)/7]/#events

Avg Annual Duration of Low Water(Percent) = 100 x [sum(weeks below criterion)]/[52 x #years]

Appendix C

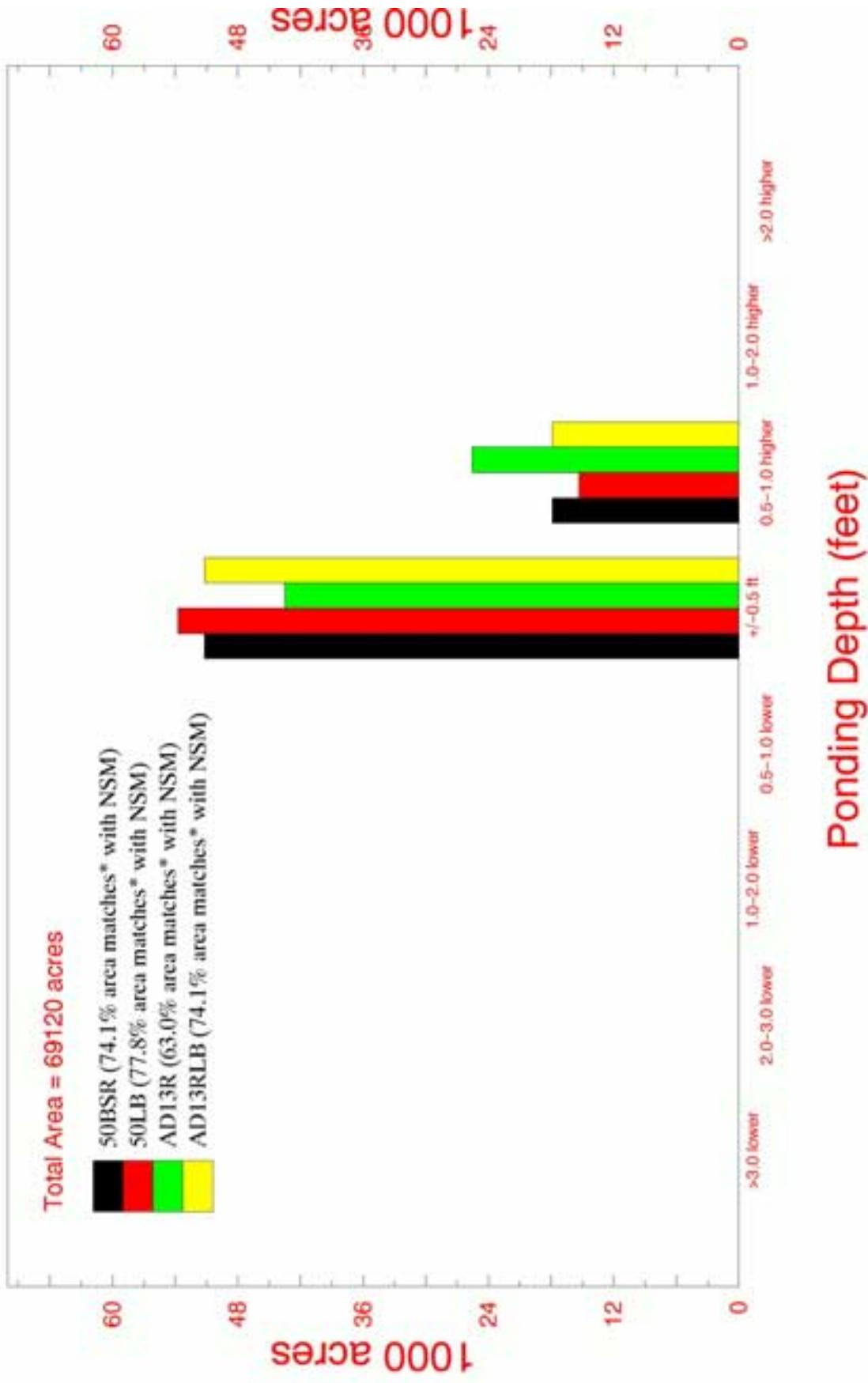
Mean NSM hydroperiod matches for WCA-3B for the 31 yr. simulation



Note: xaxis represents hydroperiod days shorter or longer as compared to NSM

*Match corresponds to 30 hydroperiod days shorter or longer than NSM.

Mean NSM ponding matches for WCA-3B for the 31 yr. simulation

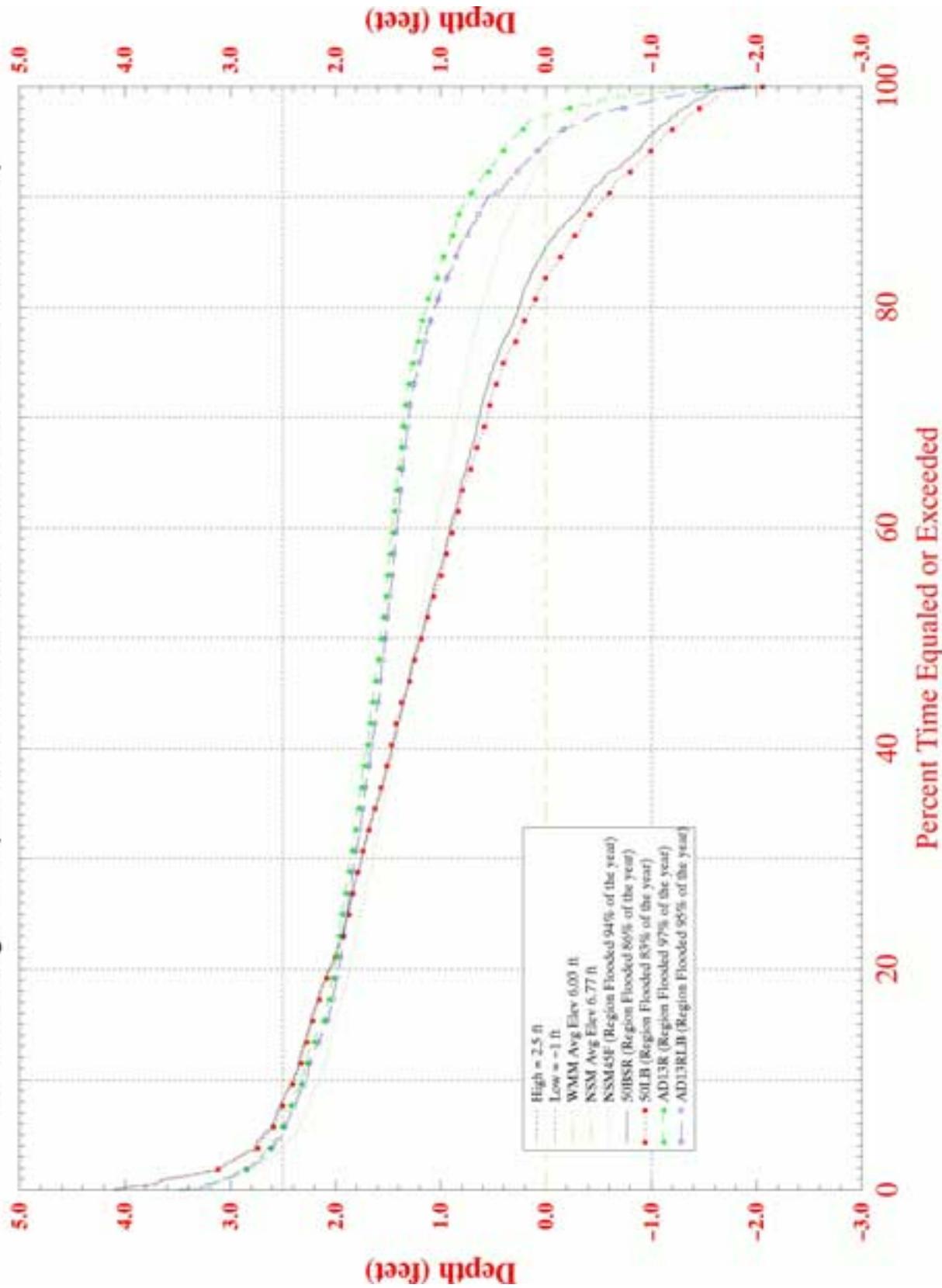


Note: xaxis represents ponding depth lesser or greater as compared to NSM
*Match corresponds to ponding depth 0.5 feet lesser or greater than NSM.

Run date: 12/21/99 17:23:22
For Planning Purposes Only
SFWMW V3.5

Normalized Weekly Stage Duration Curves for East WCA-3B

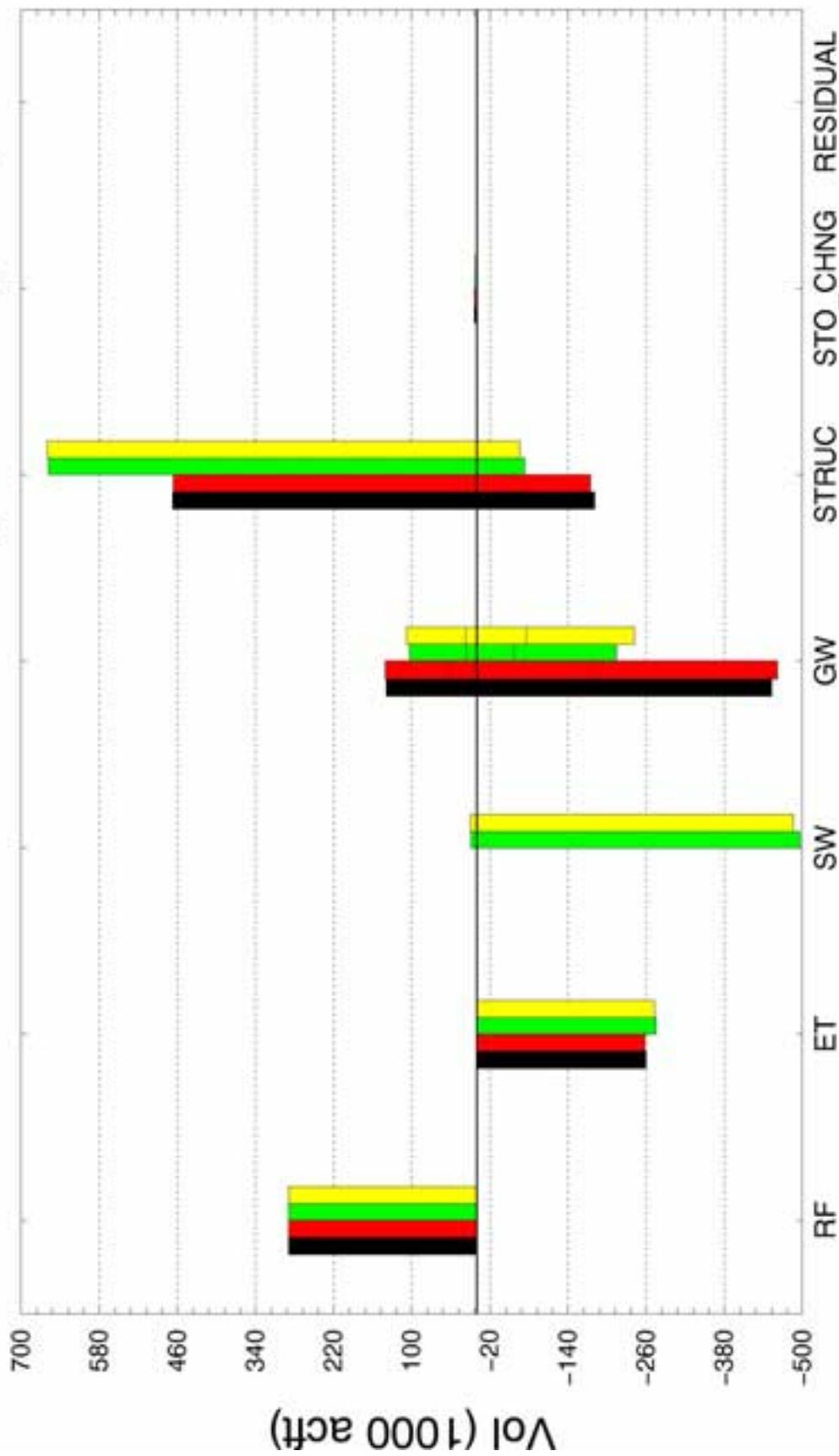
Indicator Region 16 (R23C24–26 R24C25–26 R25C26–26 R26C26–26)



Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate depth to the water table, while values below zero indicate depth to the water table.

Run date: Tue Jan 4 16:31:54 EST 2000
For Planning Purposes Only
SFWMW V3.4

Simulated Average Annual Water Budget Summary for Water Conservation Area 3B (Area 108. sq.miles)

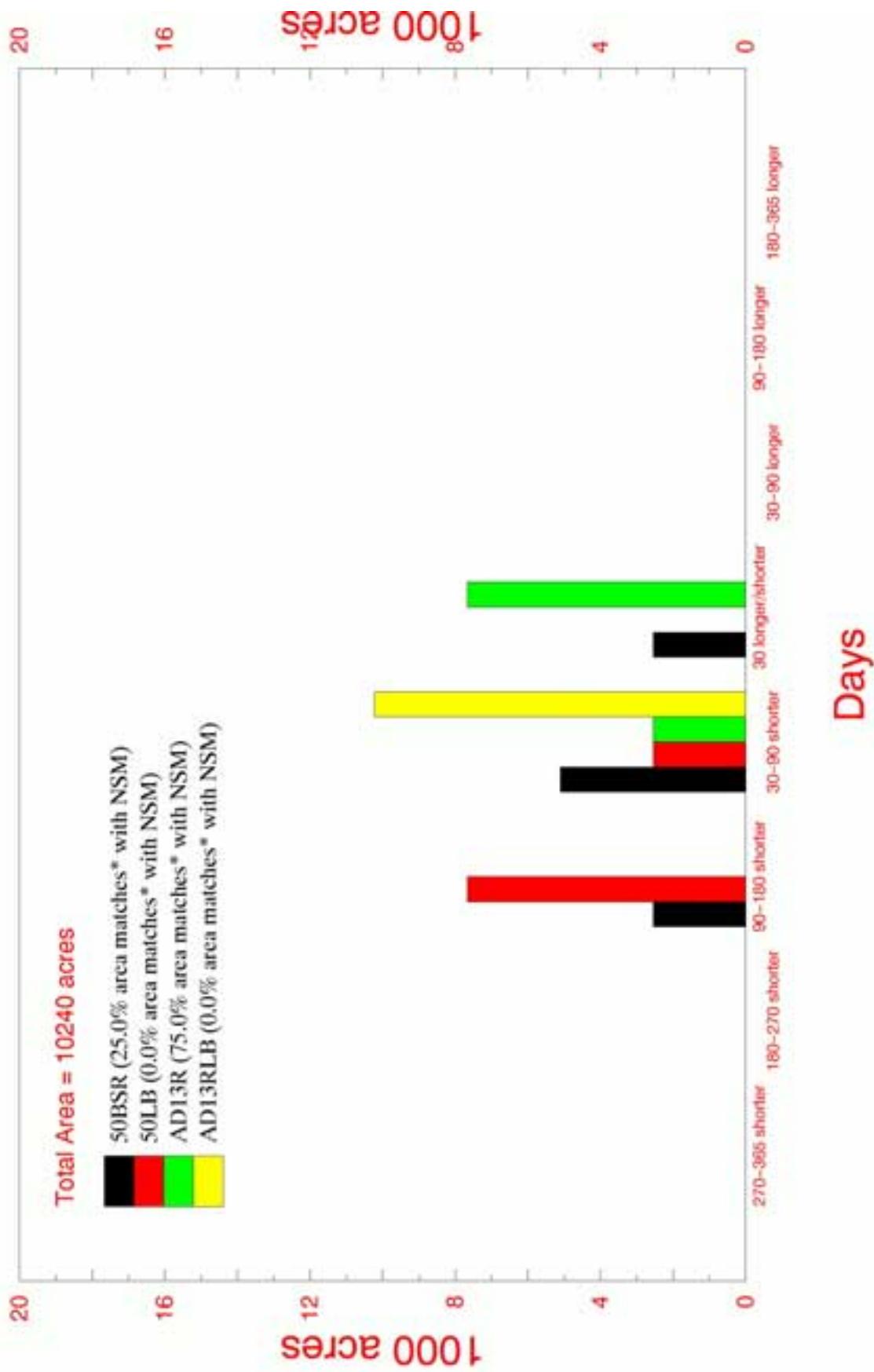


Note: Positive Volumes are Inflows to the Sub-Area while Negatives are Outflows.
GW includes Ground Water and Levee Seepage.

Run date: 01/12/00 16:29:30
For Planning Purposes Only
SFWMW v3.5

Appendix D

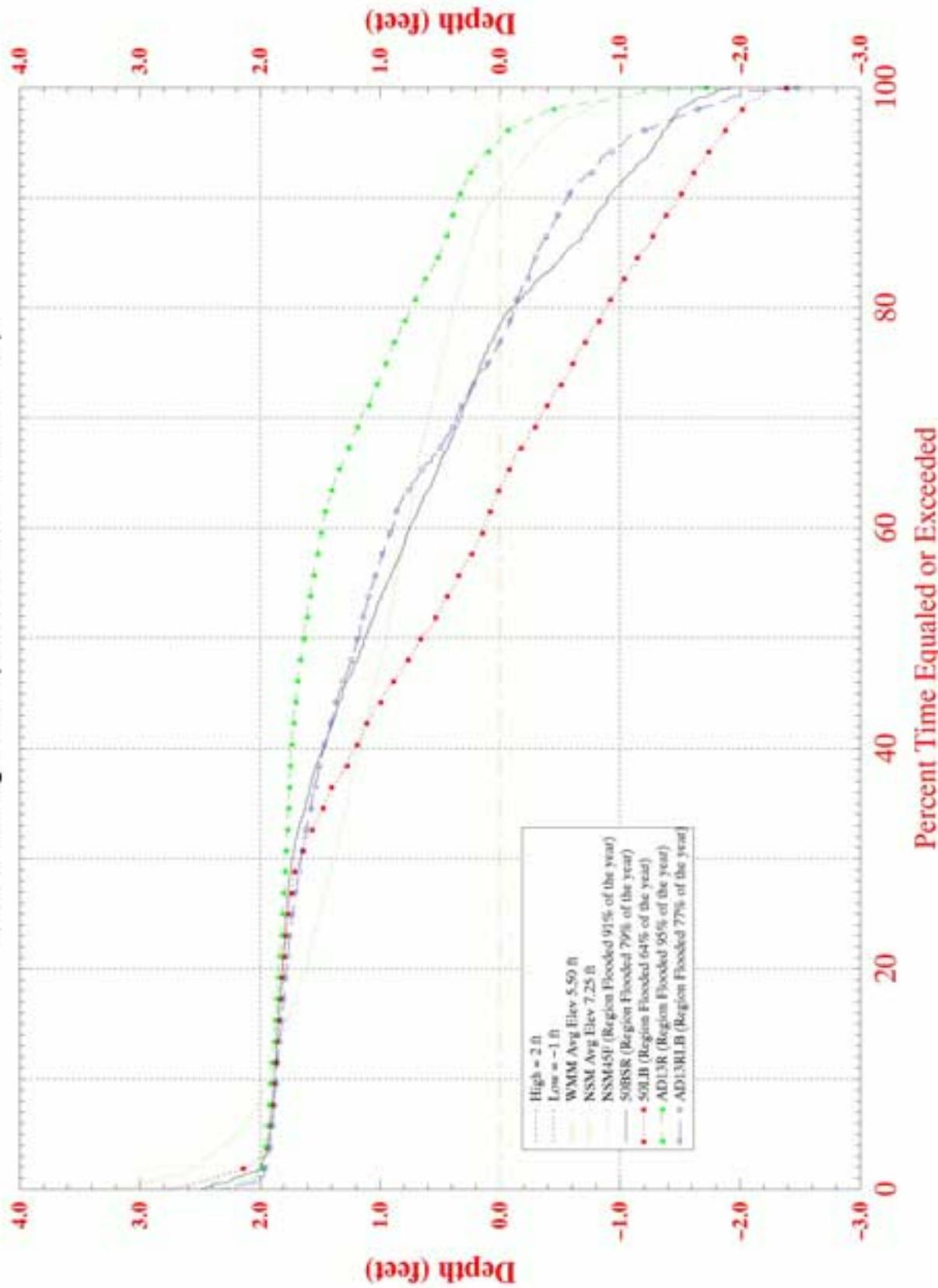
Mean NSM hydroperiod matches for PENNSUCO for the 31 yr. simulation



Note: xaxis represents hydroperiod days shorter or longer as compared to NSM
*Match corresponds to 30 hydroperiod days shorter or longer than NSM.

Normalized Weekly Stage Duration Curves for Pennsoco Wetlands North

Indicator Region 52 (R25C27-27 R26C27-27)

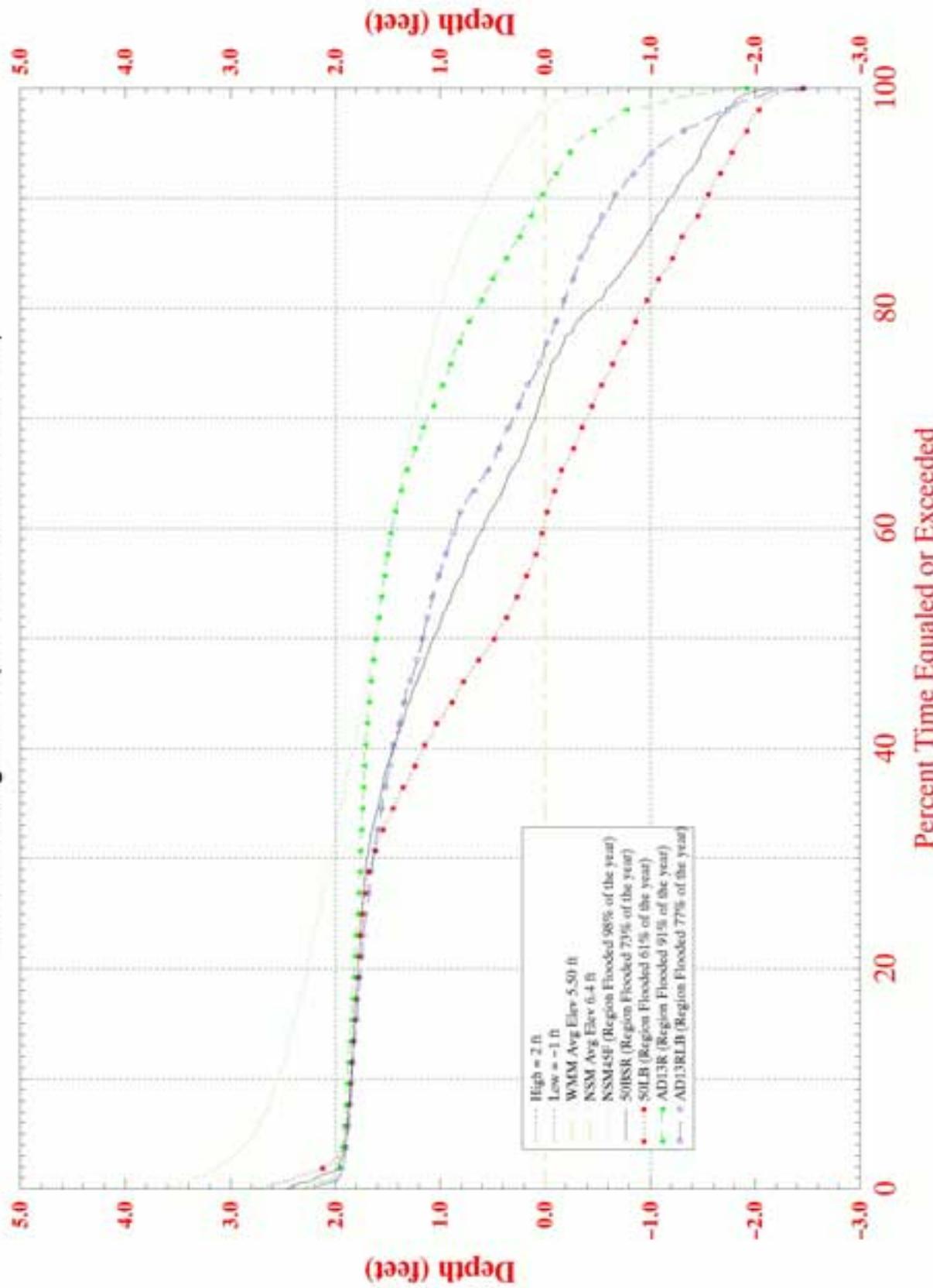


Run date: Tue Jan 4 15:30:05 EST 2000
For Planning Purposes Only
SEWMM V3.4

Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

Normalized Weekly Stage Duration Curves for Pennsoco Wetlands South

Indicator Region 53 (R23C27-27 R24C27-27)

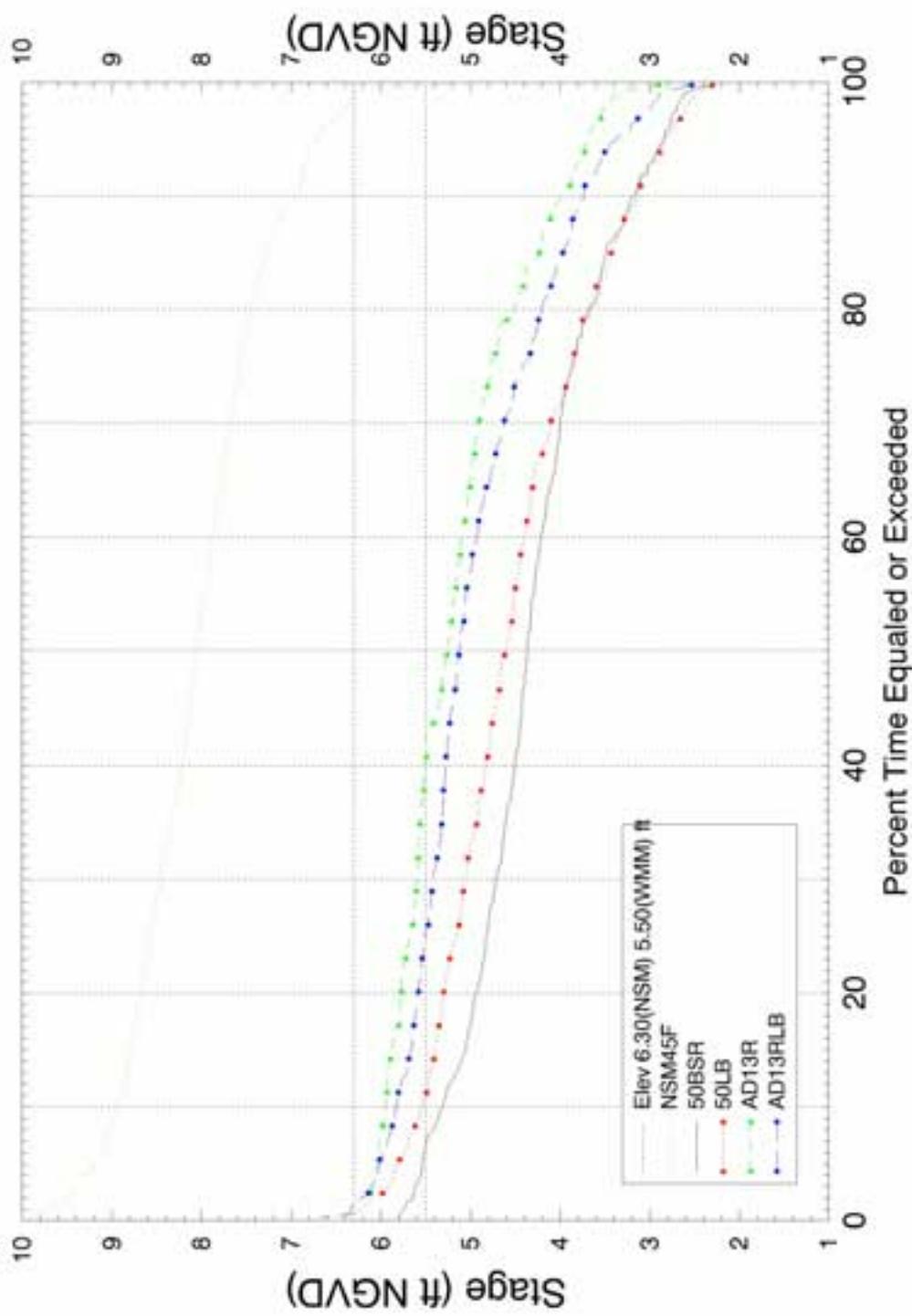


Note: Normalized stage is stage referenced to Land Elevation. Thus, values above zero indicate ponding while values below zero indicate depth to the water table.

Run date: Tue Jan 4 15:40:16 EST 2000
For Planning Purposes Only
SFWMW V3.4

Appendix E

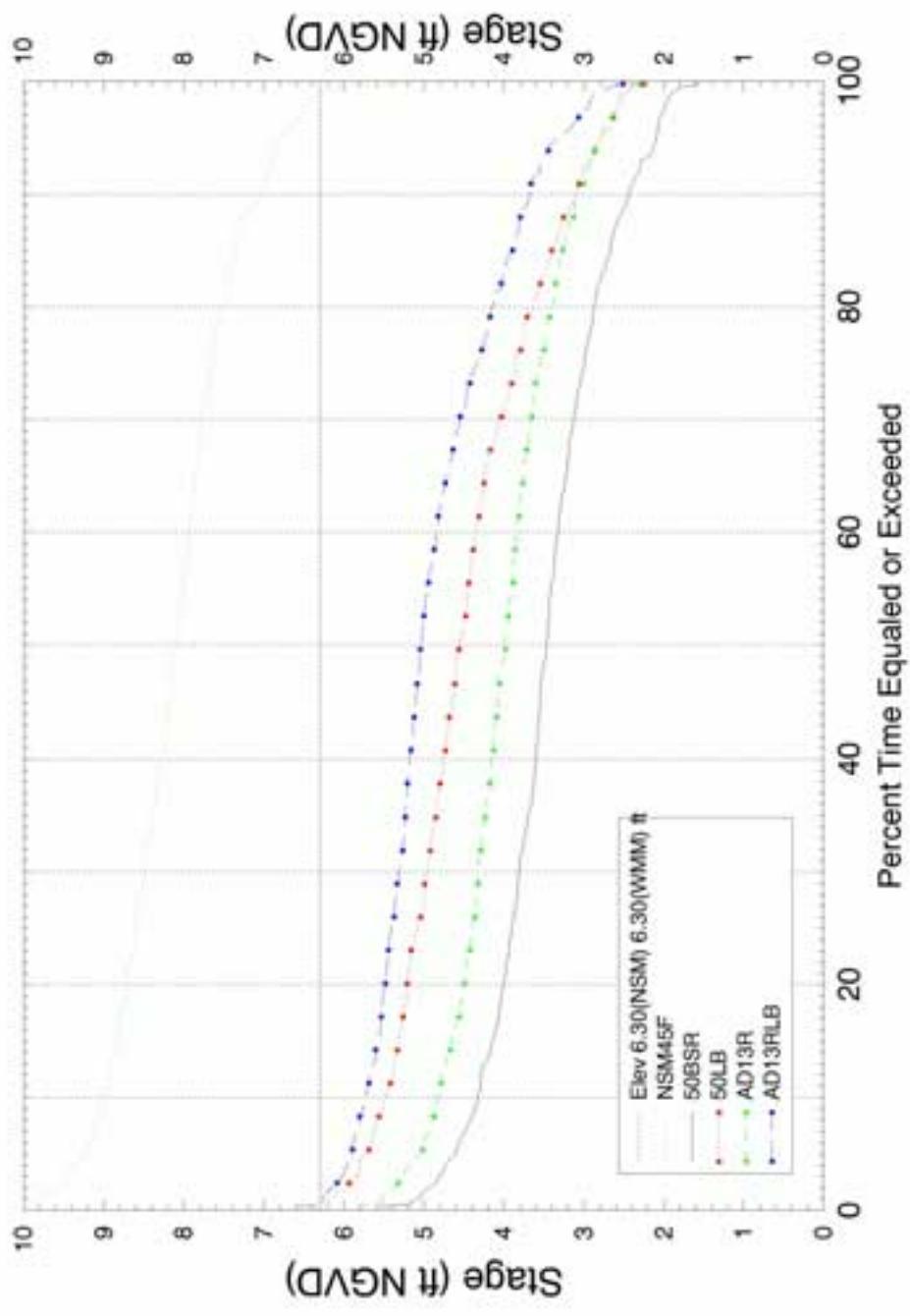
End of the Month Stage Duration Curves at Cell R23 C28 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/09 11:01:07
For Planning Purposes Only
SFWMW V3.5

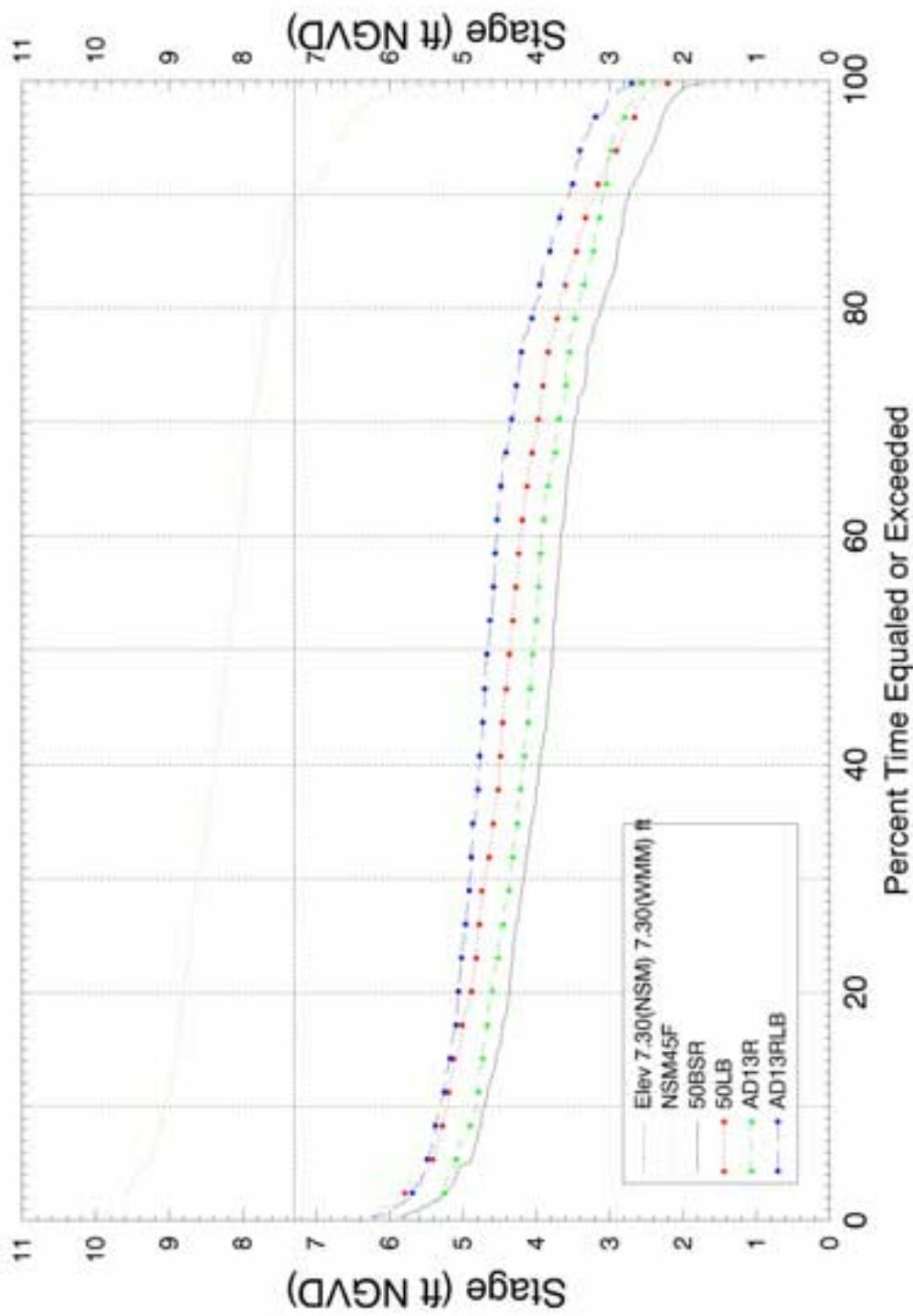
End of the Month Stage Duration Curves at Cell R23 C29 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 11:01:17
For Planning Purposes Only
SWMM V3.5

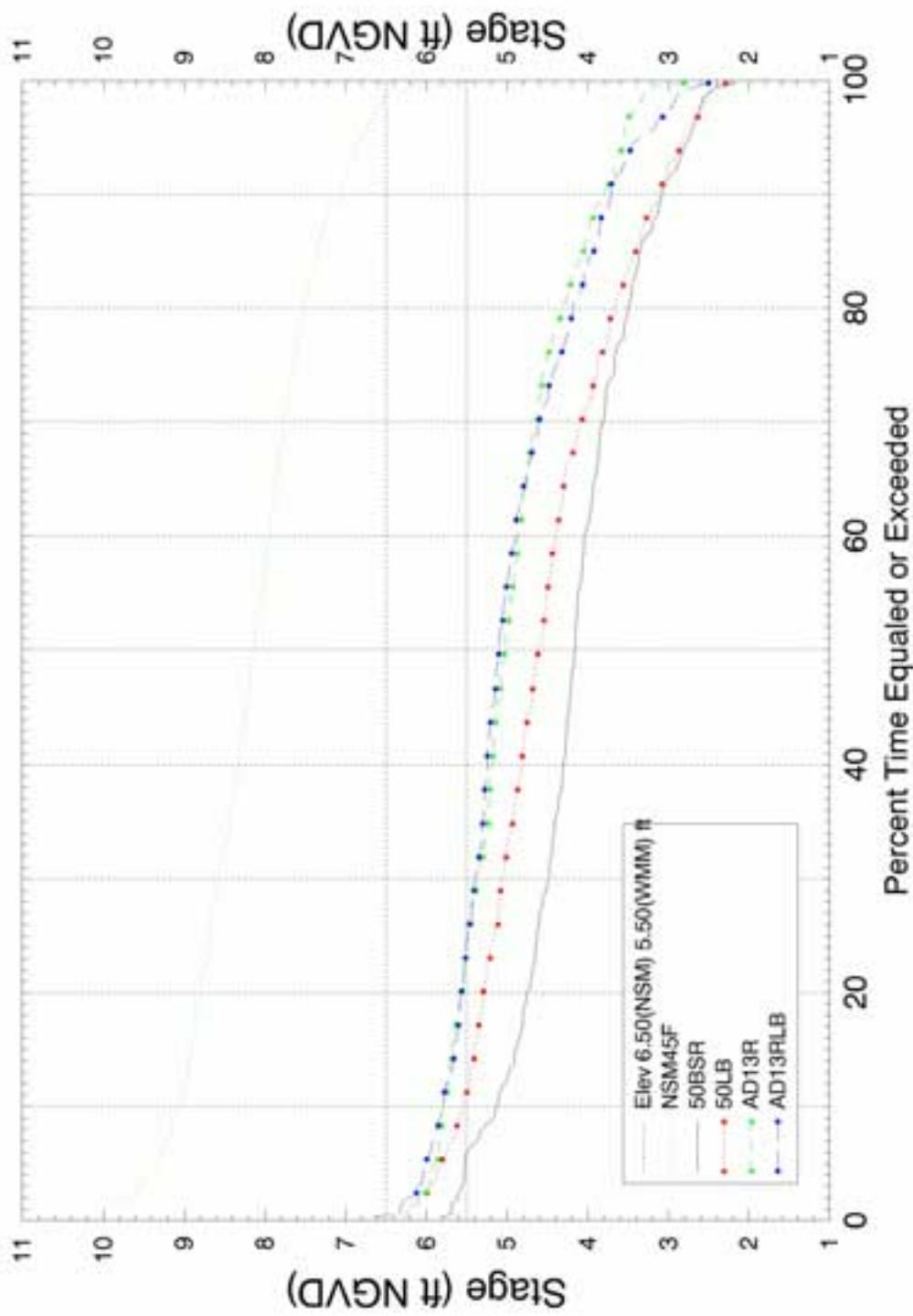
End of the Month Stage Duration Curves at Cell R23 C30 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/09 11:01:27
For Planning Purposes Only
SFWMW V3.5

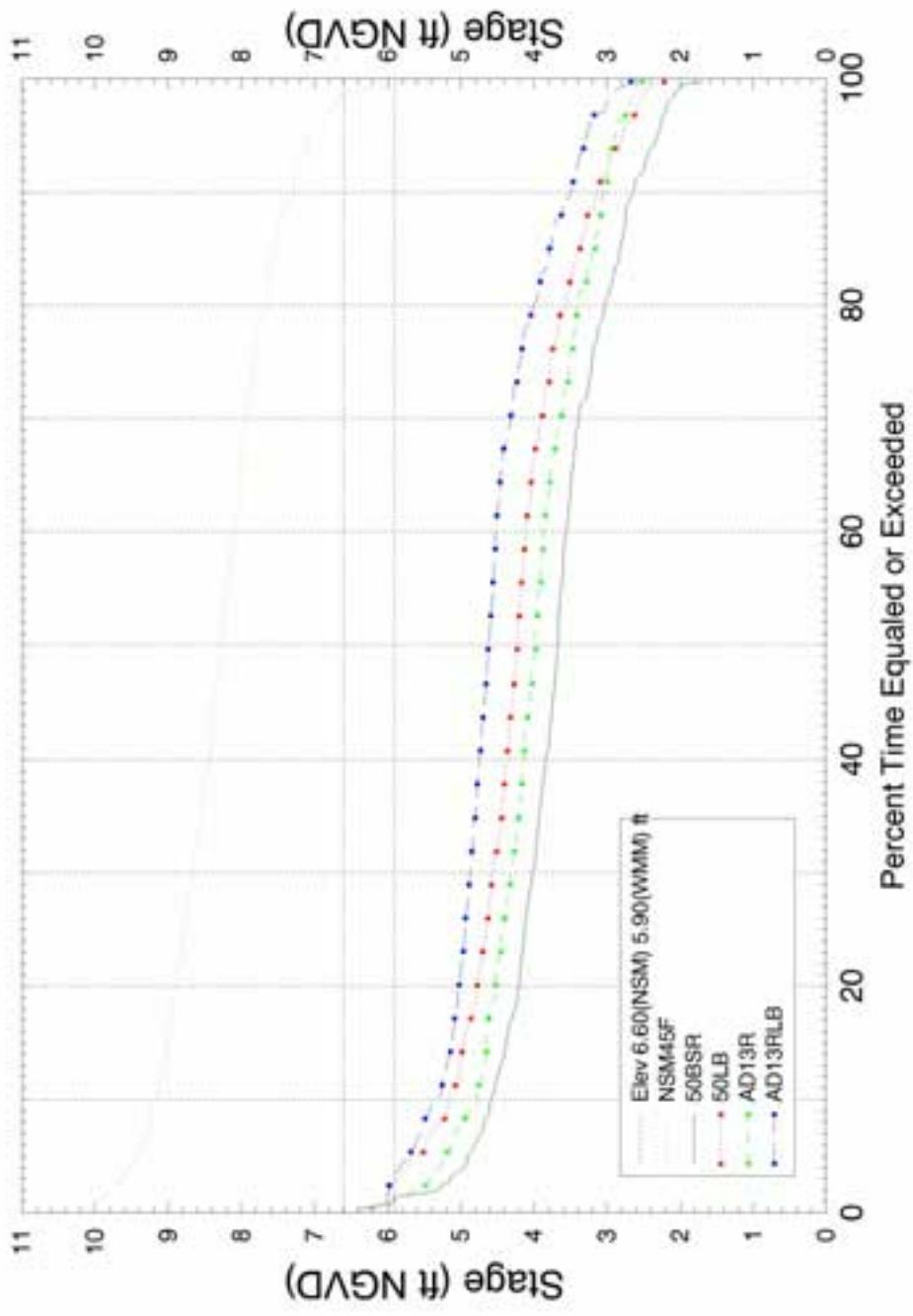
End of the Month Stage Duration Curves at Cell R24 C28 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/09 11:00:39
For Planning Purposes Only
SFWMW V3.5

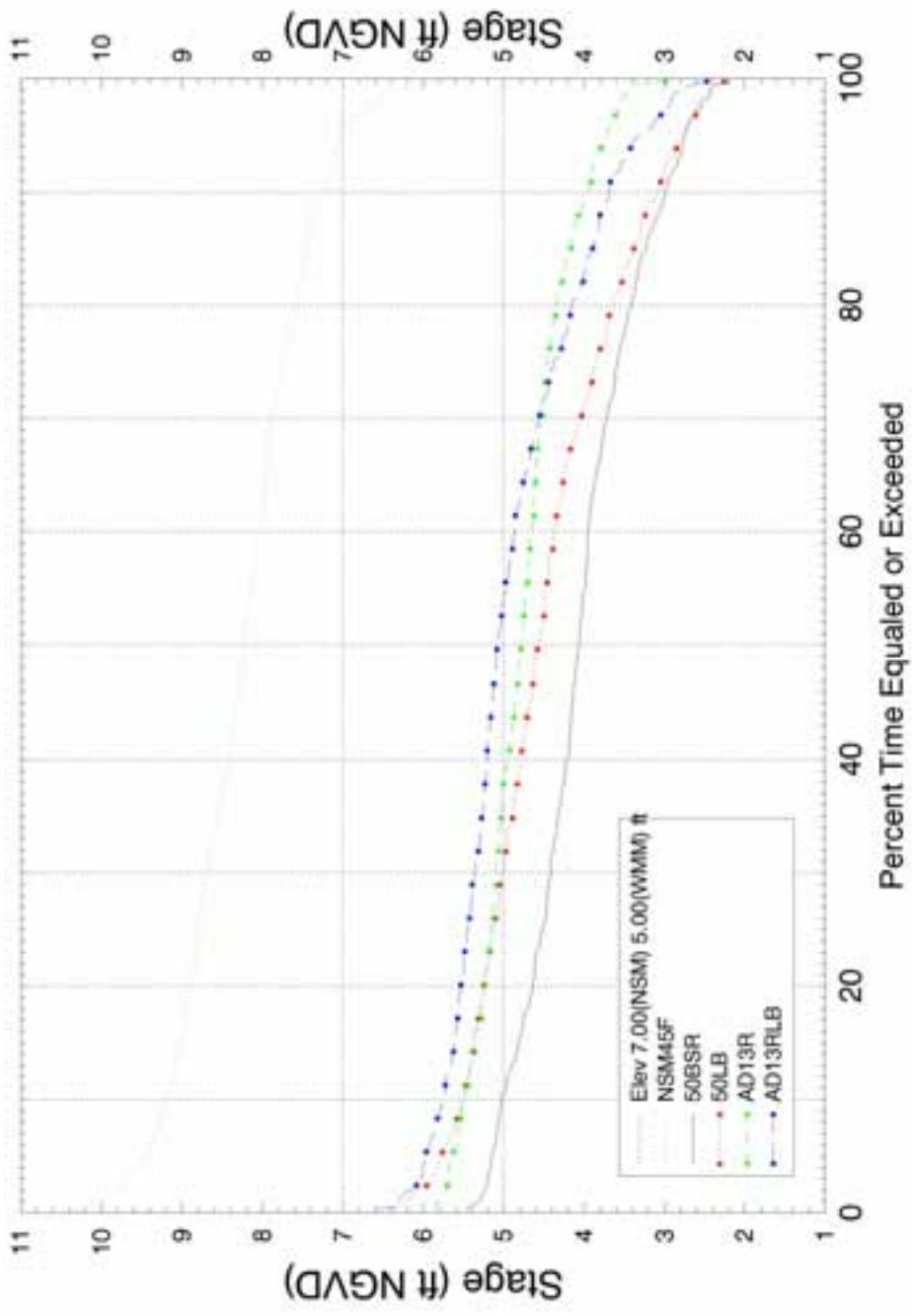
End of the Month Stage Duration Curves at Cell R24 C30 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 11:00:37
For Planning Purposes Only
SWMM V3.5

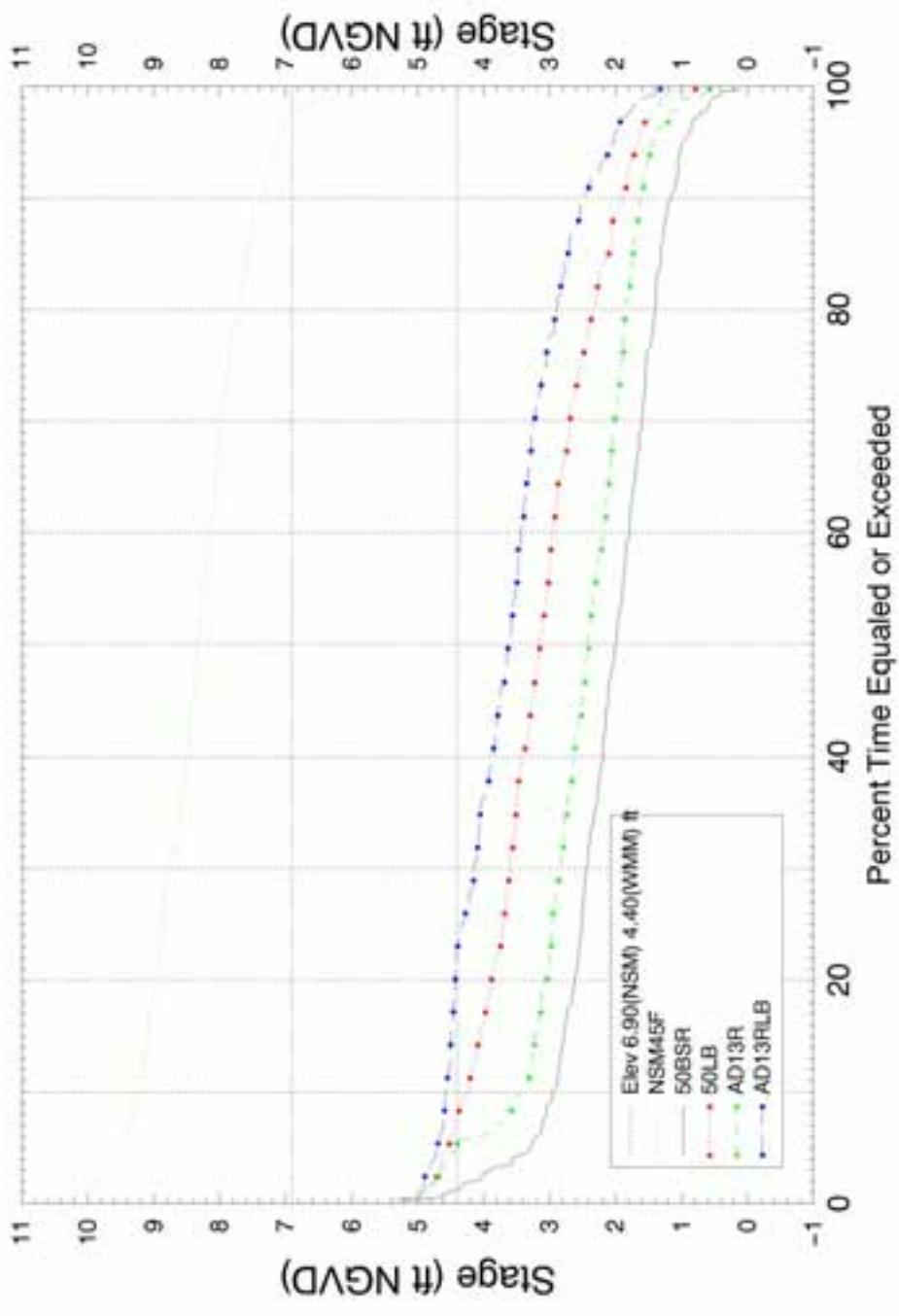
End of the Month Stage Duration Curves at Cell R25 C28 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 11:00:10
For Planning Purposes Only
SWMM V3.5

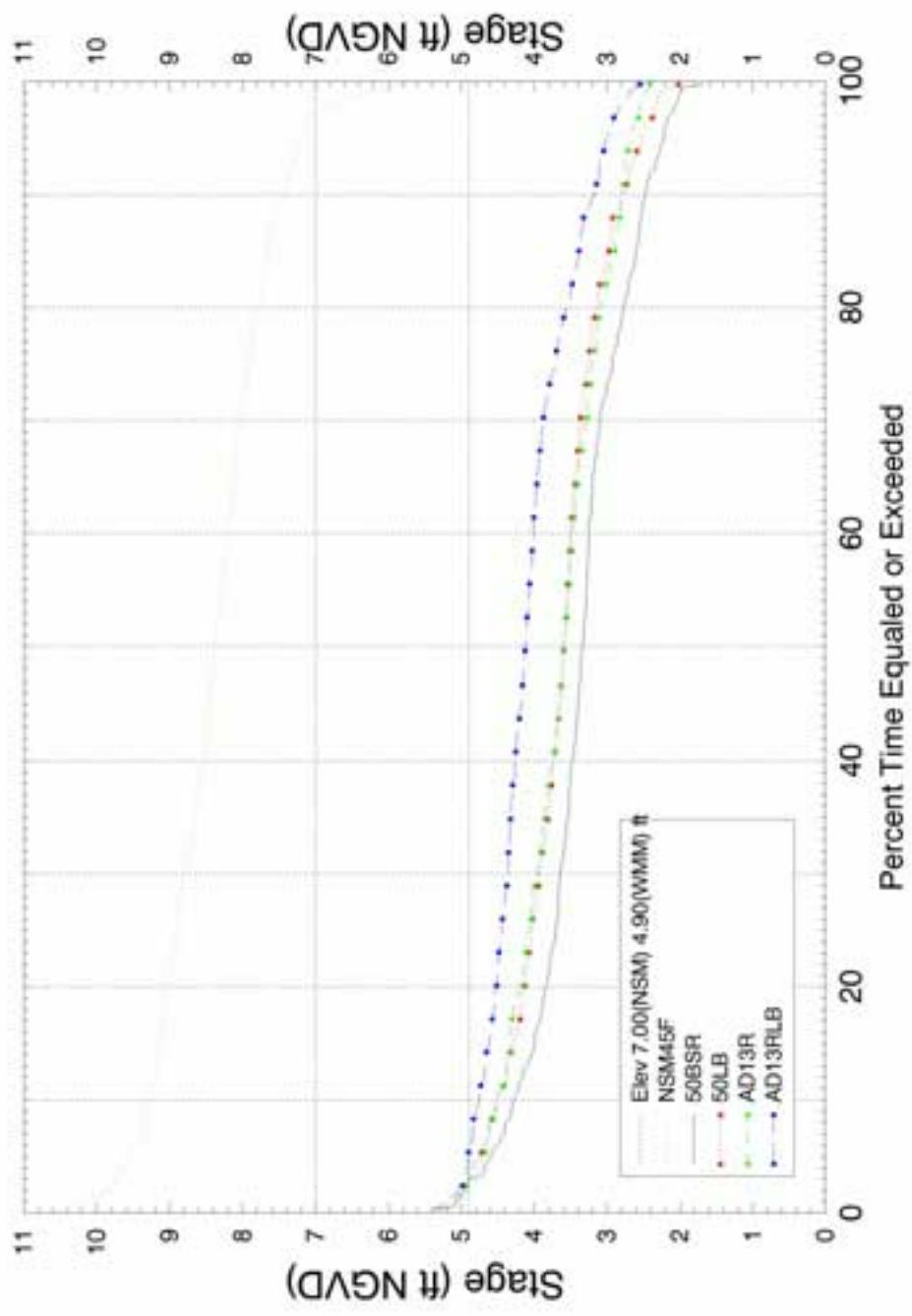
End of the Month Stage Duration Curves at Cell R25 C29 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 11:00:19
For Planning Purposes Only
SWMM V3.5

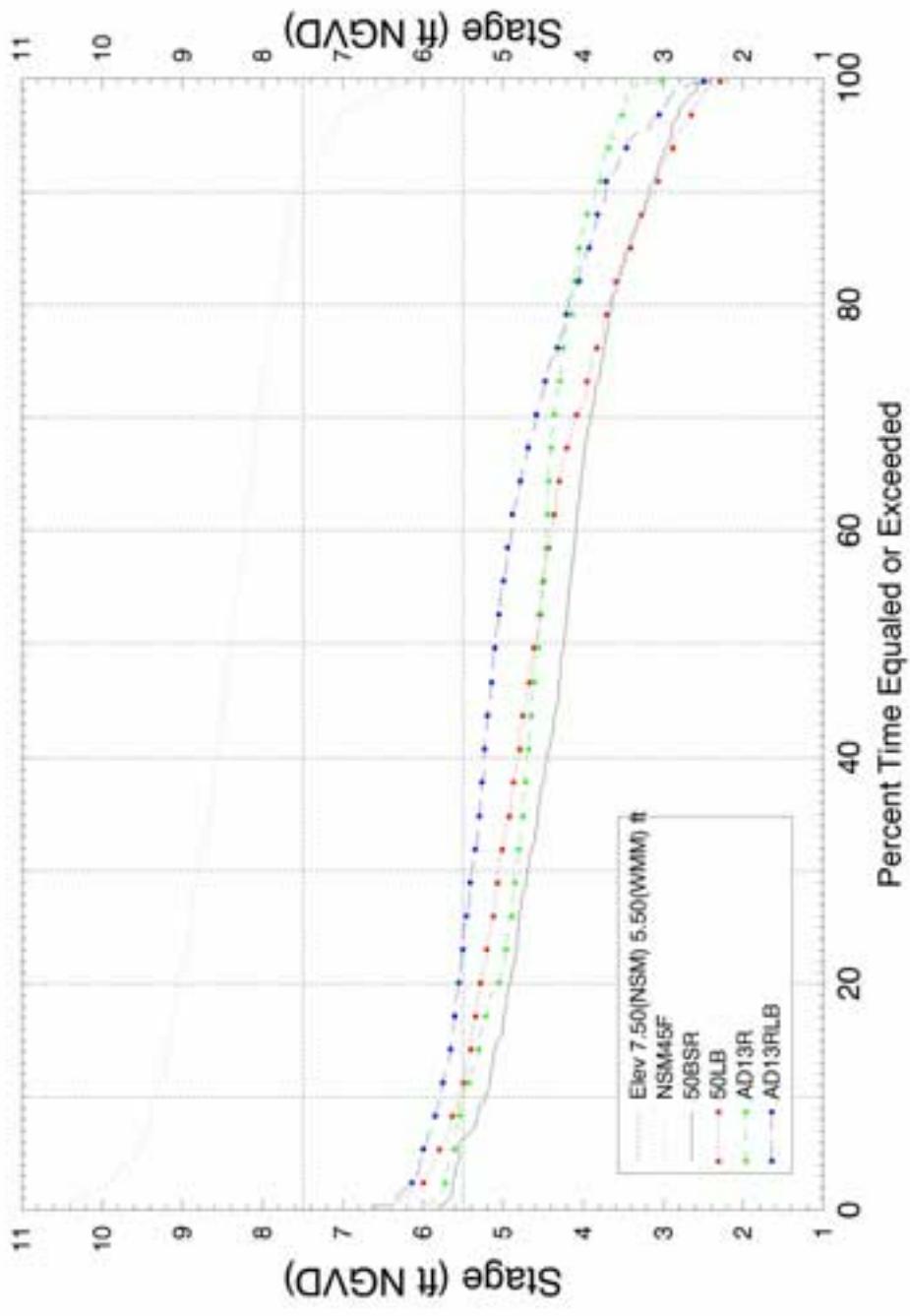
End of the Month Stage Duration Curves at Cell R25 C30 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 11:00:29
For Planning Purposes Only
SWMM V3.5

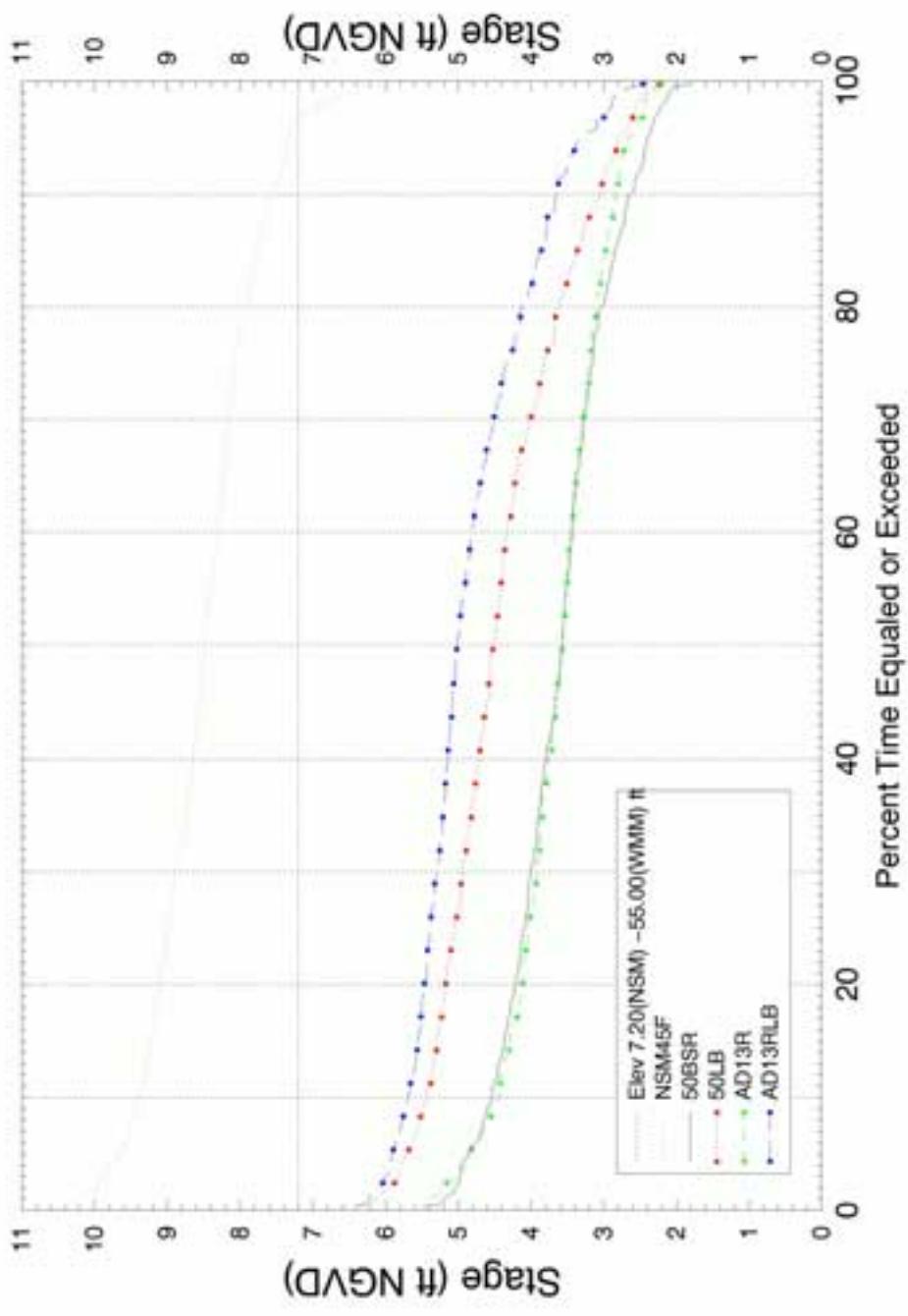
End of the Month Stage Duration Curves at Cell R26 C28 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 10:59:36
For Planning Purposes Only
SWMM V3.5

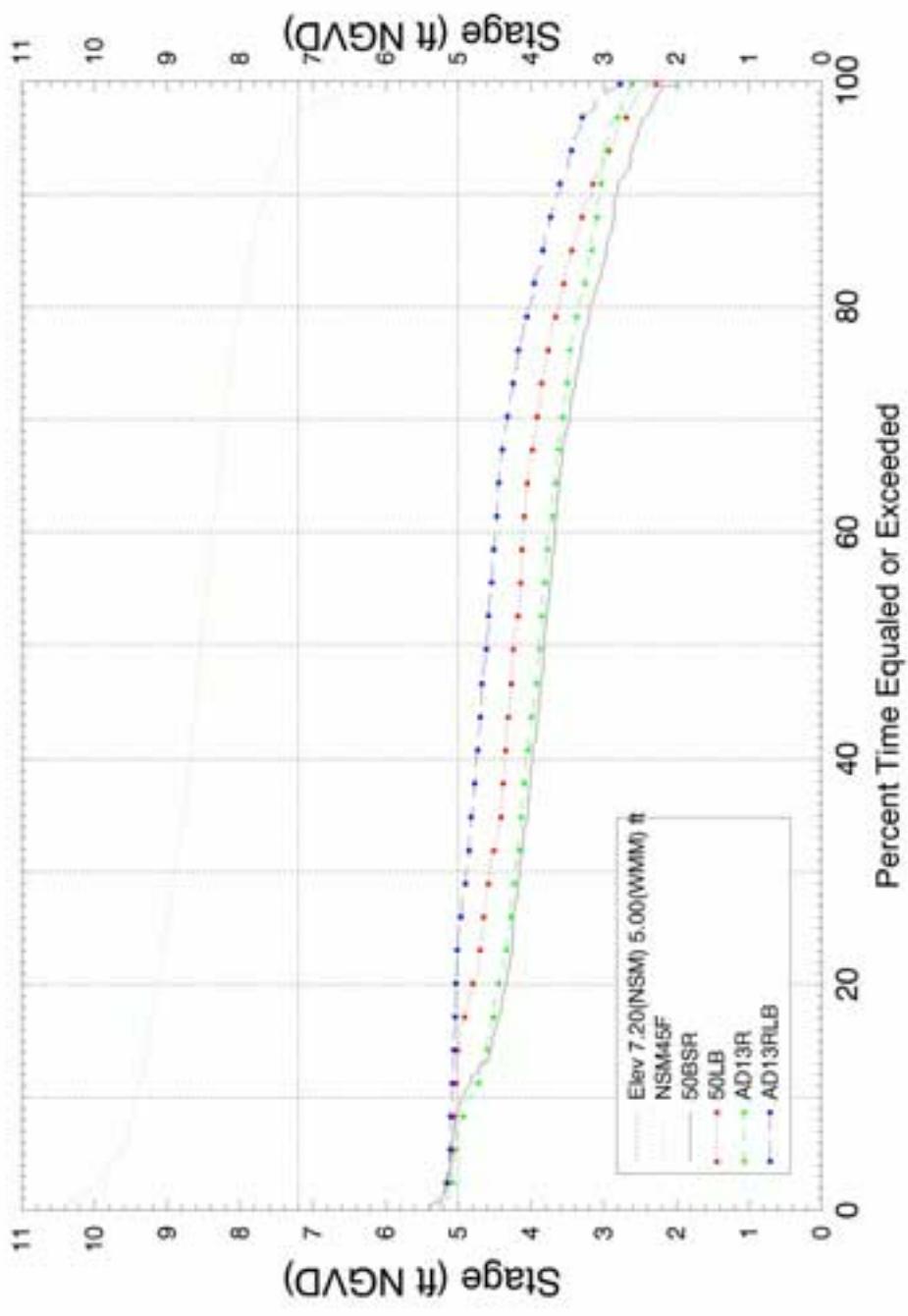
End of the Month Stage Duration Curves at Cell R26 C29 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 10:59:47
For Planning Purposes Only
SWMM V3.5

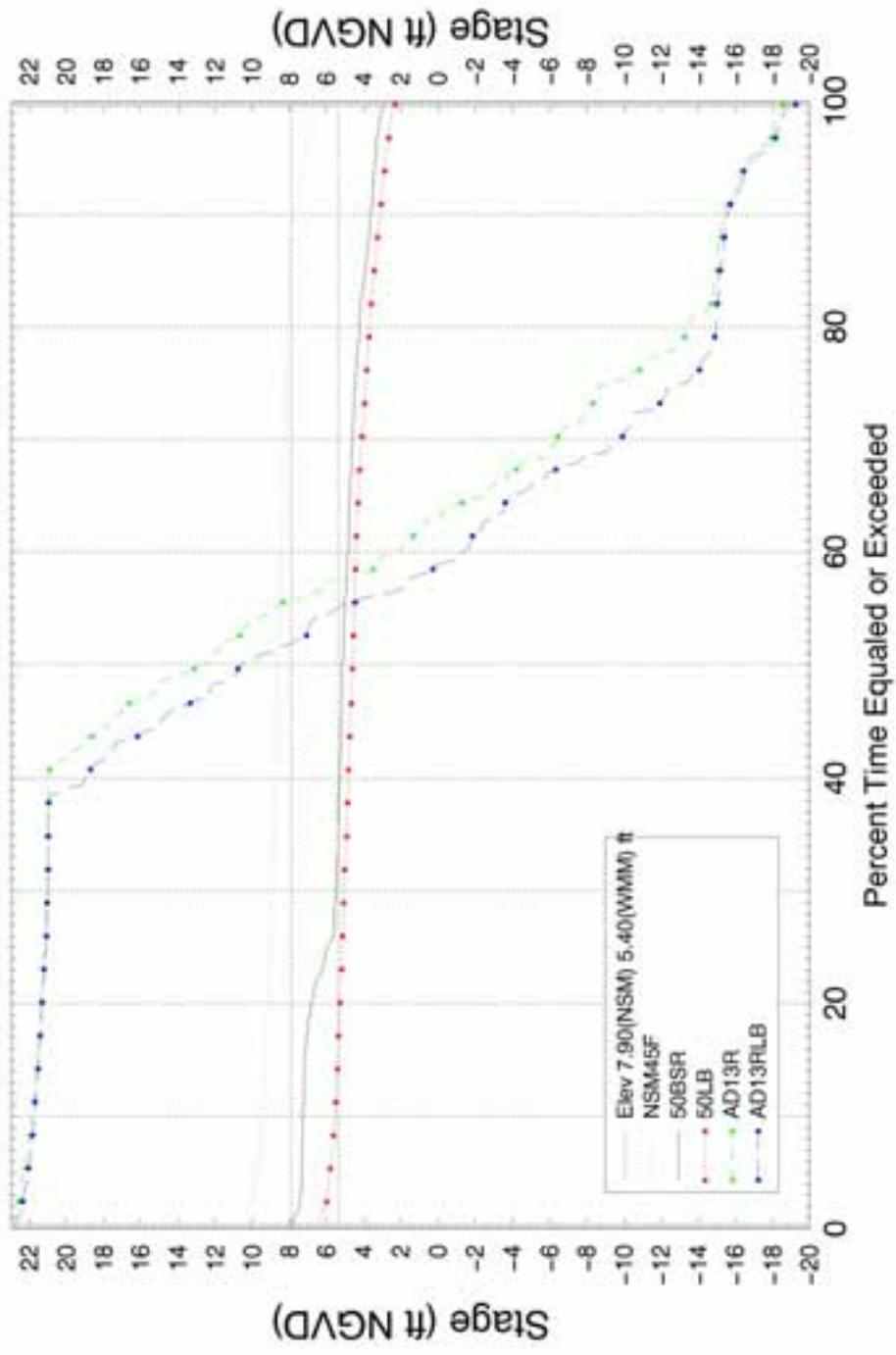
End of the Month Stage Duration Curves at Cell R26 C30 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 10:59:59
For Planning Purposes Only
SWMM V3.5

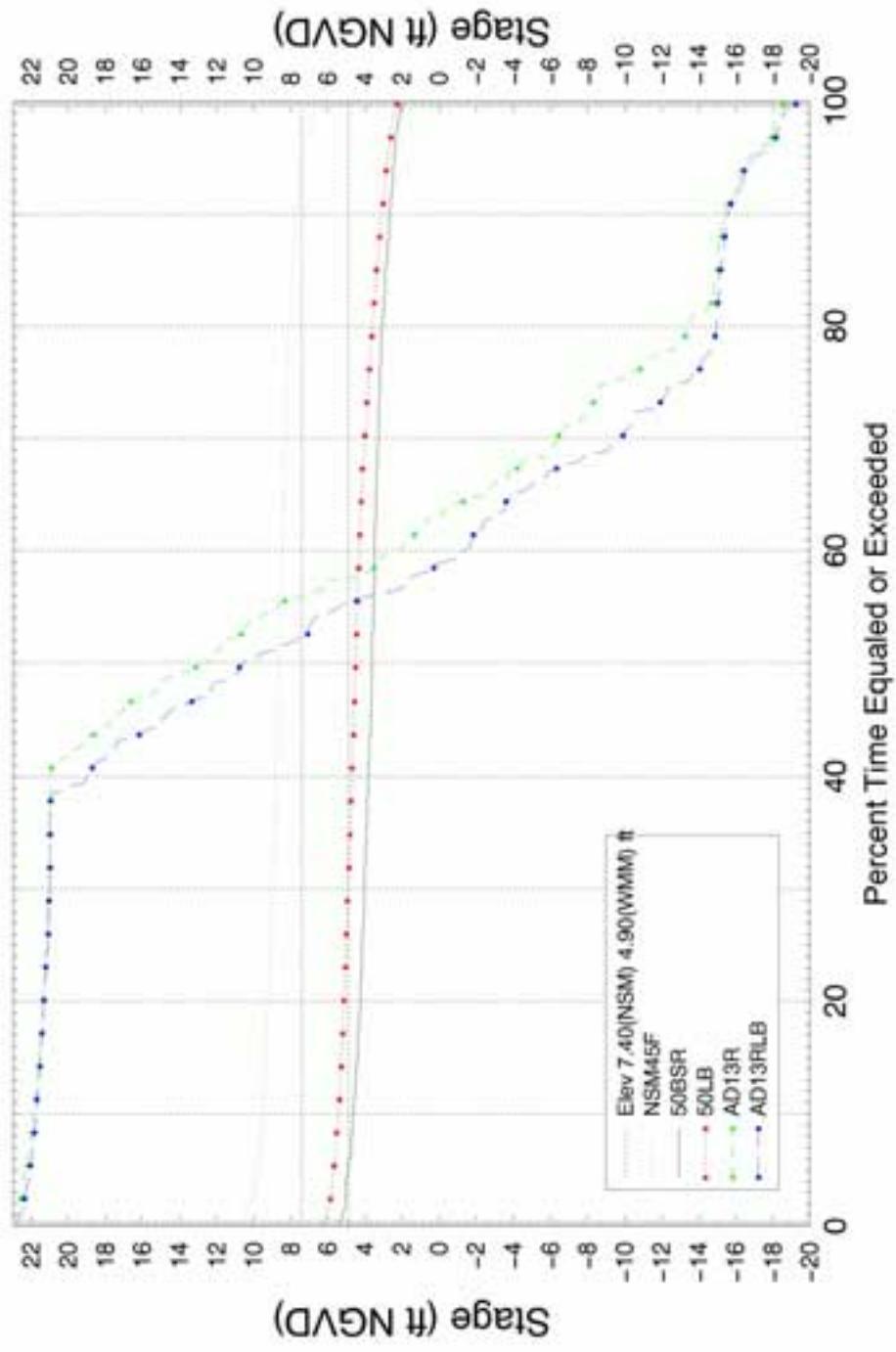
End of the Month Stage Duration Curves at Cell R27 C28 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 10:59:07
For Planning Purposes Only
SWMM V3.5

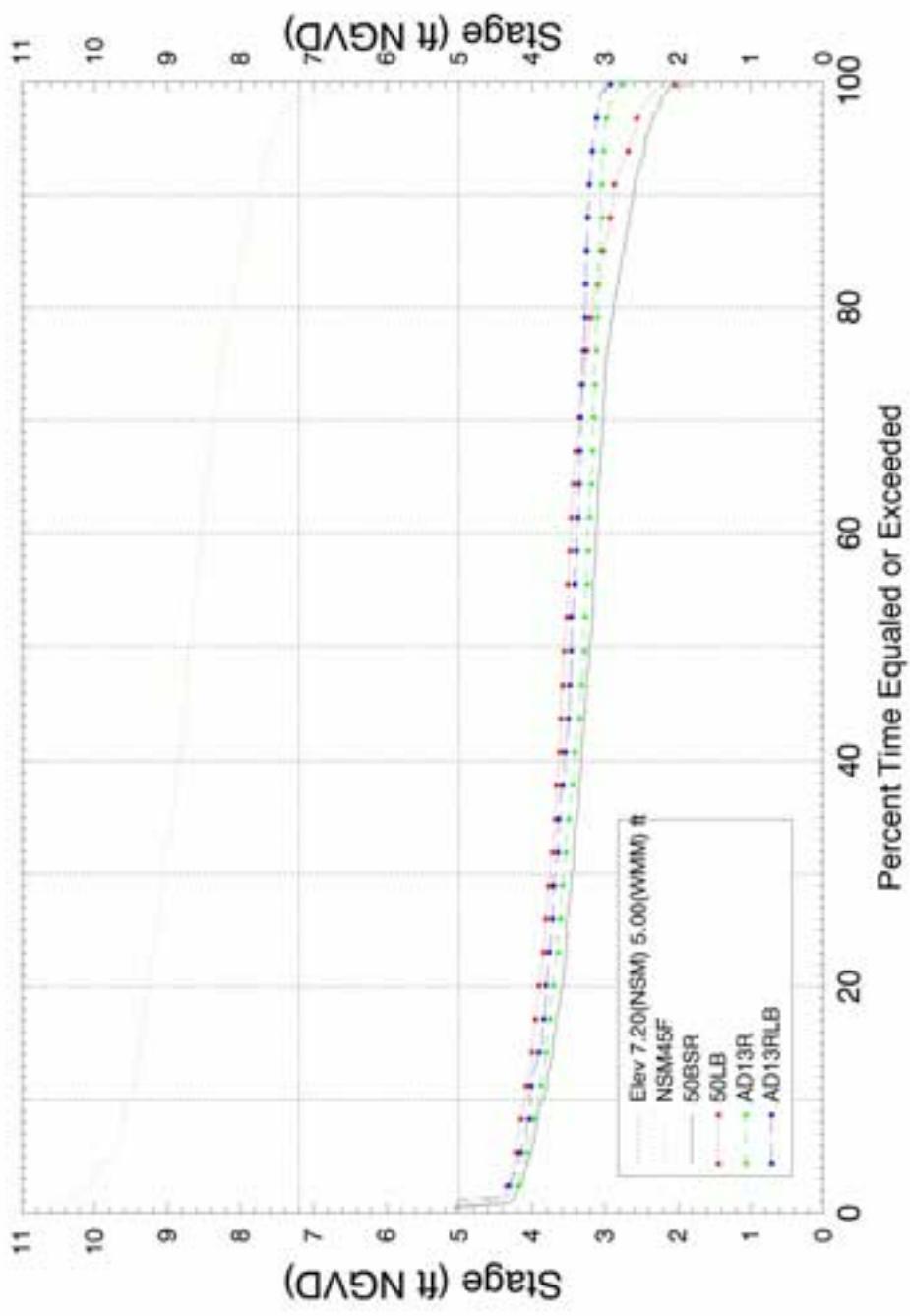
End of the Month Stage Duration Curves at Cell R27 C29 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 10:58:46
For Planning Purposes Only
SWMM V3.5

End of the Month Stage Duration Curves at Cell R27 C30 in the LEC



Note: The simulated groundwater and surface water stages represent areally AVERAGED values over a 2-mile-by-2-mile region; the values DO NOT represent specific stages, or surface water depths and durations, for specific locations within the 4-square-mile grid cell. Land elevation values also represent areally AVERAGED values over the 4-square-mile grid cell.

Run date: 01/10/00 10:59:25
For Planning Purposes Only
SWMM V3.5